HIMSS and RSNA

Integrating the Healthcare Enterprise

IHE Technical Framework
Year 2

Revision 4.0

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1   Introduction

Integrating the Healthcare Enterprise (IHE) is an initiative designed to stimulate the integration of the information systems which support modern healthcare institutions. Its fundamental objective is to ensure that in the care of patients, all required information for medical decisions is both correct and available to healthcare professionals. The initiative is sponsored by the Healthcare Information and Management Systems Society (HIMSS) and the Radiological Society of North America (RSNA).

The IHE initiative provides a visible forum for encouraging the advancement and convergence of integration efforts through the definition of a technical framework and a multi-year series of public demonstrations of products implemented by industry in accordance with that framework. This document defines the IHE Technical Framework for Year 2 of the initiative, culminating in demonstrations at the annual meetings of the RSNA in November-December 2000 and HIMSS in February 2001.

The approach employed in the IHE initiative is not to define new integration standards but rather to support the use of existing standards, e.g. DICOM, HL7, et al., in their respective domains in an integrated manner, defining configuration choices when necessary. When clarifications or extensions to existing standards are necessary, IHE refers recommendations to the relevant standards bodies.

1.1   Overview

The IHE Technical Framework identifies a subset of the functional components of the healthcare enterprise and specifies their interactions in terms of a set of coordinated transactions. The remainder of this document describes those transactions in progressively greater depth, starting with a transaction model at the enterprise level and proceeding through to the detailed definitions of each transaction.

Section 2 presents the conventions used in the IHE Technical Framework, including the structures of the interaction diagrams that specify sequences of actions in transactions and the formats of tables that define the contents of messages.

Section 3 defines the system transaction model adopted by the IHE Technical Framework. The model consists of a set of actors which interact through transactions. Actors are information systems or components of information systems which produce, manage, or act on categories of information required by operational activities in the enterprise. Transactions are interactions between actors which transfer the required information through standards-based messages. Following the transaction diagram, the actors and transactions are briefly described.

Section 4 documents the IHE data model in an Entity Relationship (ER) diagram.

Section 5 describes a set of typical process flows by documenting the sequence of transactions which take place among the involved actors. The transactions in each example are introduced in an interaction diagram which specifies the information flow and the temporal sequence.

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Section 6 defines each transaction in detail, specifying the roles for each actor, the standards employed, the information exchanged, and the conditions under which the transaction is required or optional.

The appendices following the main body of the document provide clarification of technical details of the IHE data model and transactions.

The final section of the document is a glossary of terms and acronyms used in the IHE Technical Framework, including those from relevant standards (HL7 and DICOM).

1.2   Audience

The intended audience of this document is:

- Technical staff of vendors planning to participate in the IHE initiative
- IT departments of healthcare institutions
- Experts involved in standards development
- Anyone interested in the technical aspects of integrating healthcare information systems

1.3   Relationship to Standards

The IHE Technical Framework identifies functional components of a distributed healthcare environment solely from the point of view of their interactions in the healthcare enterprise. At its current level of development, it defines a coordinated set of transactions based on the HL7 and DICOM standards. As the scope of the IHE initiative expands, transactions based on other standards will be included as required.

In some cases, IHE recommends selection of specific options supported by these standards; however, IHE does not introduce technical choices that contradict conformance to these standards. If errors in or extensions to existing standards are identified, IHE's policy is to submit those to the appropriate standards bodies for resolution within their conformance and standards evolution strategy. IHE is therefore an implementation framework, not a standard. Referencing IHE as a standard and claiming conformance to IHE are both inappropriate. Conformance claims shall be made in direct reference to specific standards.DICOM or HL7 conformance statements may, however, state that the products they describe are "implemented in accordance with the IHE Technical Framework".

IHE encourages implementors to ensure that products implemented in accordance with the IHE Technical Framework also meet the full requirements of the standards underlying IHE, allowing the products to interact, although possibly at a lower level of integration, with products which have been implemented in compliance with the standards but which may not meet the IHE requirements.

1.4   Relationship to Real-world Architectures

The actors and transactions described in the IHE Technical Framework are abstractions of the real-world healthcare information system environment. While some of the transactions are

traditionally performed by specific product categories (e.g., HIS, RIS, PACS, or modalities), the IHE Technical Framework intentionally does not associate functions or actors with such product categories. For each actor, the IHE Technical Framework defines only those functions associated with integrating information systems. The IHE definition of an actor should therefore not be taken as the complete definition of any product which might implement it, nor should the framework itself be taken as the complete definition of a healthcare information system architecture. The reason for defining actors and transactions is to provide a basis for defining the interactions among functional components of the healthcare information system environment. In situations where a single physical product implements multiple functions, only the interfaces between the product and external functions in the environment are considered to be significant by the IHE initiative. Therefore, the IHE initiative takes no position on the relative merits of an integrated environment based on a single, all-encompassing information system and one based on multiple systems which together achieve the same end. To illustrate most dramatically the possibilities of the IHE Technical Framework, however, the IHE demonstrations emphasize the integration of multiple vendors' systems based on the IHE Technical Framework.

1.5   Year 2 Scope Additions

This document refers to Year 2 of the IHE initiative. It will be the basis for demonstrations at RSNA 2000 and HIMSS 2001. The IHE Technical Framework: Year 2 adds the following primary features to those of previous years:

- Images Available
- Access to Radiology Information
- Access to Non-Radiology Information
- Patient Information Reconciliation
- Consistent Presentation of Images
- Report Management

1.6   Comments

HIMSS and RSNA welcome comments on this document and the IHE initiative. They should be directed to:

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1.7   Copyright Permission

Health Level Seven, Inc., has granted permission to the IHE for reproducing tables from the HL7 standard. The HL7 tables in this document are copyrighted by Health Level Seven, Inc. All rights reserved.

The National Electrical Manufacturers Association (NEMA) has granted permission to the IHE to incorporate portions of the DICOM standard.

Material drawn from these documents is credited where used.

2 Conventions

The IHE Technical Framework identifies actors which interact through transactions. Actors are information systems or components of information systems which produce, manage, or act on information associated with operational activities in the enterprise. Transactions are interactions between actors which transfer the required information through standards-based messages.

2.1 The Generic IHE Transaction Model

Transaction descriptions are provided in section 6. In each transaction description, the actors, the roles they play, and the transactions between them are presented as use cases.

The generic IHE transaction description includes the following components:

- Scope: a brief description of the transaction.
- Use case roles: textual definitions of the actors and their roles, with a simple diagram relating them, e.g.:
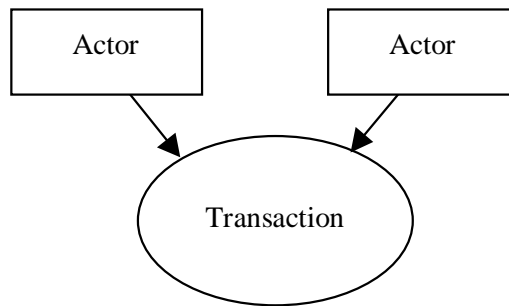
- Referenced Standards: the standards (HL7, DICOM, et. al.) to be used for the transaction.
- Interaction Diagram: a graphical depiction of the actors and transactions, with related processing within an actor shown as a rectangle and time progressing downward, similar to:

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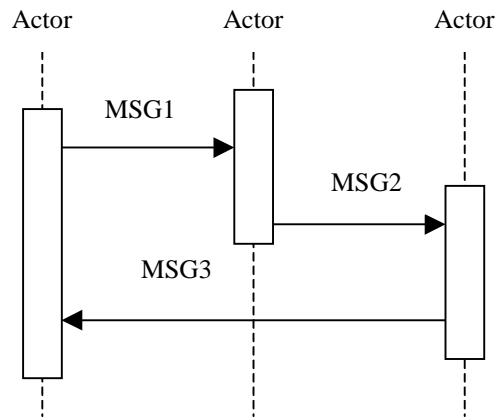
The interaction diagrams used in the IHE Technical Framework are modelled after those described in Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, ISBN 0-201-57168-4. Simple acknowledgment messages are omitted from the diagrams for brevity.

- Message definitions: descriptions of each message involved in the transaction, the events which trigger it, its semantics, the actions which it triggers in the receiver.

2.2   DICOM Usage Conventions

For some DICOM transactions described in this document, IHE has strengthened the requirements on the use of selected Type 2 and Type 3 attributes. These situations are explicitly documented in section 6 and in the appendices.

IHE specifically emphasizes that DICOM Type 2 attributes (for instance, Patient Name, Patient ID) shall be transmitted with zero length if the source system does not possess valid values for such attributes; in other words, the source system shall not assign default values to such attributes. The receiving system must be able to handle zero-length values for such attributes.

IHE has also defined requirements related to the support for and use of matching and return keys in DICOM queries by both Service Class Users (SCUs) and Service Class Providers (SCPs):

- Required matching key:

    A key that the Query SCU shall have the ability to offer to its user as a selection criterion. The definition of the means offered to the user of the Image Display to trigger the sending of a matching key in the Query request is beyond the scope of IHE. The Query SCP uses a required matching key as a selection criterion in matching instances for return to the SCU in the query responses.

- Required return key:

    A key that the Query SCU requests from the Query SCP, receives in the query responses, and displays for the user, if required. The definition of the means offered

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to the user of the Image Display to request a return key and to make it visible to the user is beyond the scope of IHE.

Note: matching keys are used to select instances for return by the query SCP to the SCU, whereas return keys return specific data and are not used for matching.

The following legend is used by tables in section 6 to specify key requirements for SCUs and SCPs:

R   Required by DICOM

R+   Required IHE extension of the DICOM requirements

R*   Required return key which is not required to be displayed

O   Optional

Table 2.2-1 provides an example table defining matching and return keys.

Table 2.2-1. Images Query Matching and Return Keys

Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Study Level						
Study Date	(0008,0020)	R+	R	R+	R	
Study Time	(0008,0030)	R+	R	R+	R	
Accession Number	(0008,0050)	R+	R	R+	R	
Patient name	(0010,0010)	R+	R	R+	R	
Patient ID	(0010,0020)	R+	R	R+	R	
Study ID	(0020,0010)	R+	R	R+	R	
Study Instance UID	(0020,000D)	R+*	R	O	R	
Modalities in Study	(0008,0061)	R+	R+	O	R+	
Referring Physician's Name	(0008,0090)	R+	R+	R+	R+	
Study Description	(0008,1030)	O	O	O	O	

2.3   HL7 Profiling Conventions

The HL7 tables included in this document have been modified from the HL7 2.3.1 standard document. Such a modification is called a profile. Refer to the HL7 2.3.1 standard for the meanings of specific columns in the table.

The profiling tables in this document leverage the ongoing HL7 profile definition. To maintain this specification at a generic level, the following differences have been introduced:

- Message specifications do not indicate the cardinality of segments within a message.
- For fields composed of multiple components, there is no indication of the size of each component.

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- Where a table containing enumerated values is referenced from within a segment profile table, the enumerated values table is not always present.

- The number of times a repeating field can repeat is not indicated.

- The conditions which would require inclusion of conditional fields are not defined.

The following terms refer to the OPT column, which has been profiled:

R   Required

R2   This is an IHE extension. If the sending application has data for the field, it is required to populate the field. If the value is not known, the field may not be sent.

O   Optional

C   Conditional

IHE requires that Z-segments be present in HL7 transactions only when defined by the IHE Technical Framework.

Table 2.3-1 provides an example profile for an imaginary HL7 segment. Tables for real segments are copied from the HL7 2.3.1 standard with modifications made only to the OPT column.

Table 2.3-1. Example HL7 Profile

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R		xx001	Element 1
2	4	ST	O		xx002	Element 2
3	180	HD	R2		xx003	Element 3
4	180	HD	C		xx004	Element 4
5	180	HD	O		xx005	Element 5
6	180	HD	R		xx006	Element 6

2.4   HL7 Implementation Notes

2.4.1   Network Guidelines

The HL7 2.3.1 standard does not define a network communications protocol. The HL7 2.1 standard defines lower layer protocols in an appendix. These definitions were moved to the Implementation Guide in 2.2 and subsequent versions but are not HL7 requirements. The IHE Framework makes these recommendations:

1. Applications shall use the Minimal Lower Layer Protocol defined in appendix C of the HL7 Implementation Guide.

2. An application that wants to send a message (initiate a transaction) will initiate a network connection to start the transaction. The receiver application will respond with

an acknowledgement or response to query but will not initiate new transactions on this network connection.

2.4.2   Acknowledgment Modes

Applications that receive HL7 messages shall send acknowledgments using the HL7 Original Mode (versus Enhanced Acknowledgment Mode).

2.4.3   HL7 and DICOM Mapping Considerations

Field lengths are explicitly defined in the DICOM standard, but an HL7 element might consist of multiple components which do not have a defined maximum length. It is recognized that there are some HL7 component lengths which could be longer than the DICOM attribute lengths. Data values for mapped fields are required not to exceed the smaller of either the HL7 or the DICOM field length definitions. Systems supporting alternative character sets must take into account the number of bytes per character in such sets. All systems are required to support the DICOM Default Character Set (ISO-IR 6 or ASCII). In addition, other character sets may be supported. Maintaining consistency of data encoded using alternative character sets is outside of scope of the IHE Technical Framework: Year 2.

Value Representations are not explicitly addressed. Attention should be given to the mapping of the HL7 representation and the DICOM representation. Examples of these include Patient Name, dates, times, etc.

3   System Transactions Overview

The System Transaction Overview (figure 3-1) identifies significant actors and the flow of information between them - the transactions – throughout the clinical process addressed by the IHE Technical Framework: Year 2. Product implementations may support more than one actor based on the grouping rules specified in the section 3.3.
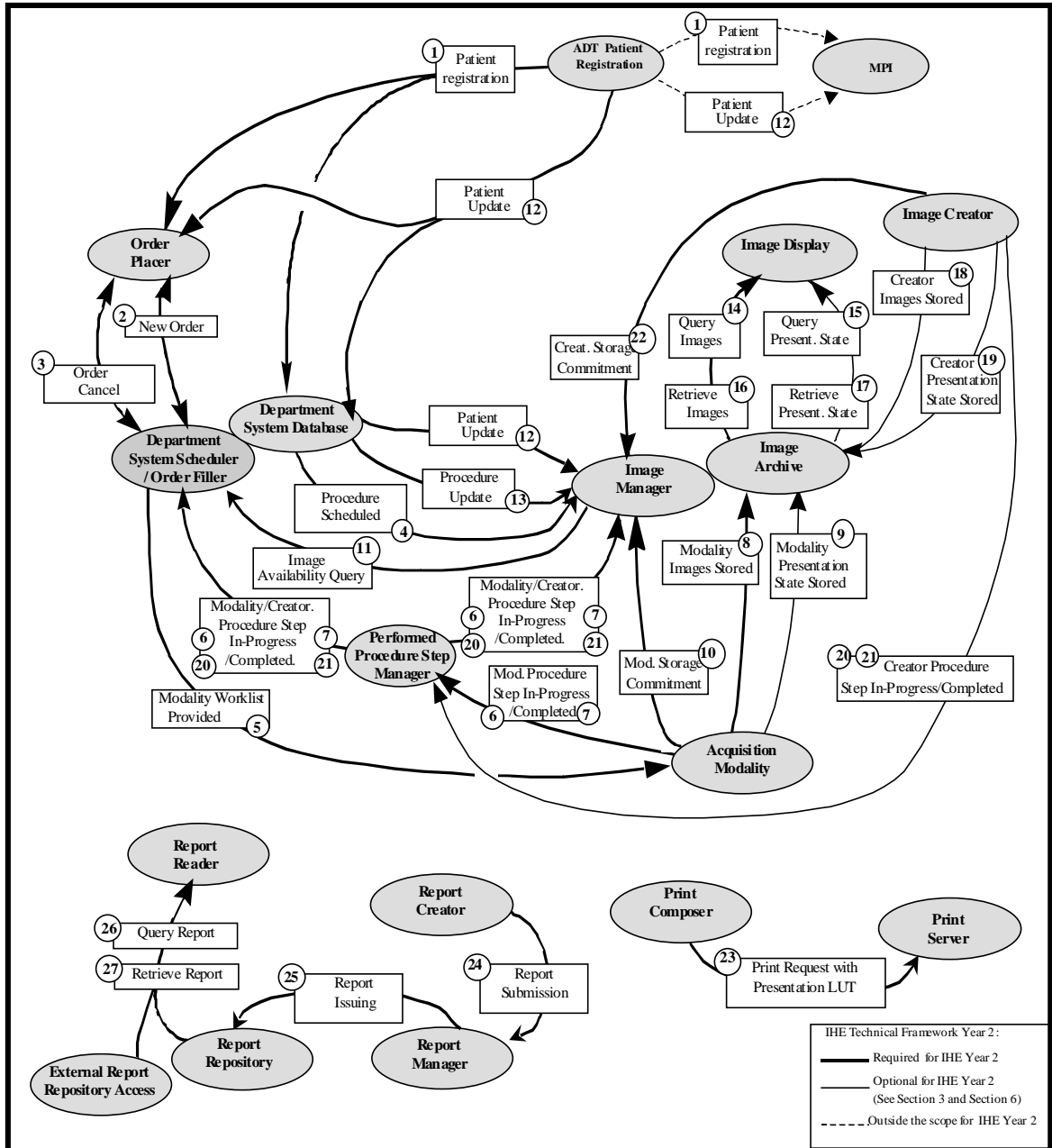

Figure 3-1. System Transactions Overview

3.1   Actor Descriptions

In the figure 3-1, ovals represent actors whose definitions are listed below.

Acquisition Modality – A system that creates and acquires medical images, e.g. a Computed Tomography scanner or Nuclear Medicine camera. May also create Grayscale Softcopy Presentation States for the consistent viewing of images.

ADT Patient Registration – A system responsible for adding and/or updating patient demographic and encounter information. In particular, registers a new patient with identification and sends the update to the Order Placer and Department System Database.

Order Placer – A hospital or enterprise-wide system that generates orders for various departments and distributes those orders to the correct department.

Department System Database – A database component of the department-based information system (for instance, Radiology or Laboratory) which stores all relevant data about patients, orders, and their fulfillment.

Department System Scheduler/Order Filler – A department-based information system (for instance, Radiology or Laboratory) or its component that schedules (assigns) material and other resources so as to perform procedures according to orders it receives from external systems or through the user interface.

External Report Repository Access – A system that performs retrieval of clinical reports containing information generated from outside the Radiology department and presented as DICOM Structured Reporting Objects.

Image Archive – A system that provides long term storage of image and presentation data.

Image Creator – A system that creates additional images and/or Grayscale Softcopy Presentation States and transmits the data to an Image Archive. It also makes requests for storage commitment to the Image Manager for the images and/or Presentation States previously transmitted and generates Performed Procedure Steps.

Image Display – A system that offers browsing of patients' studies with series of images. In addition, supports the retrieval of selected set of images and their presentation characteristics specified by modality (size, color, annotations, layout, etc.).

Image Manager – A system that provides functions related to safe data storage and image data handling. It supplies image availability information to the Department System Scheduler.

Master Patient Index – A system that maintains unique enterprise-wide identifier for a patient.

Performed Procedure Step Manager – A system that provides a service of re-distributing the Modality Performed Procedure Step information from the Acquisition Modality or Image Creator to the Department System Scheduler/Order Filler and Image Manager actors.

Print Composer –A system that generates DICOM print requests to the Print Server Actor. Print requests include presentation state information in the form of Presentation Look-Up Tables (Presentation LUTs).

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Print Server – A system that accepts and processes DICOM print requests as a DICOM Print SCP and performs image rendering on hardcopy media. The system must support pixel rendering according to the DICOM Grayscale Standard Display Function.

Report Creator – A system that generates and transmits draft (and optionally, final) reports, presenting them as DICOM Structured Reporting Objects.

Report Manager – A system that provides functions related to report management. This involves the ability to handle content and state changes to reports and to create new DICOM Structured Reporting Objects based on these changes.

Report Reader – A system that can query/retrieve and view reports presented as DICOM Structured Reporting Objects.

Report Repository – A system that provides long-term storage of reports and their retrieval as DICOM Structured Reporting Objects.

3.2   Transaction Descriptions

This section describes the transactions found in figure 3-1. The transaction numbers and titles correspond those of the figure.

1. **Patient Registration** – The patient is registered/admitted. This will generate a visit or encounter event as well as a registration event if the patient is not pre-existing.

2. **New Order** – An order is created via an order entry system (Order Placer); an order may contain procedures that cross multiple departments. Department-specific orders/ procedures are forwarded to the appropriate department. The Order Filler informs an Order Placer about the order's status changes. An order may also be generated by the Order Filler in a department and submitted to the Order Placer.

3. **Order Cancel** – A previously placed order is terminated or changed. Either the Order Placer or the Departmental System Scheduler/Order Filler may need to change order information or cancel/discontinue an order. When order information change is necessary, the IHE Technical Framework: Year 2 requires that initiatorcancel the order and generate the new one using new information. All systems that are aware of the order are informed of the change, including the Image Manager if the order has been scheduled as one or more procedures.

4. **Procedure Scheduled** – Schedule information is sent from the DSS/Order Filler to the Image Manager.

5. **Modality Worklist Provided** – Based on a query entered at the Acquisition Modality, a modality worklist is generated listing all the items that satisfy the query. This list of Scheduled Procedure Steps with selected demographic information is returned to the Acquisition Modality.

6. **Modality Procedure Step In Progress** – An Acquisition Modality notifies the Performed Procedure Step Manager of a new Procedure Step.

7. **Modality Procedure Step Completed** – An Acquisition Modality notifies the Performed Procedure Step Manager of the completion of a Procedure Step.

8. **Modality Images Stored** – An Acquisition Modality requests that the Image Archive store acquired or generated images.

9. **Modality Presentation State Stored** – An Acquisition Modality requests that the Image Archive store the Grayscale Softcopy Presentation State (GSPS) for the acquired or generated images.

10. **Modality Storage Commitment** – An Acquisition Modality requests that the Image Manager take responsibility for the specified images and/or GSPS objects the Acquisition Modality stored.

11. **Images Availability Query** – The Department System Scheduler/Order Filler asks the Image Manager if a particular image or image series is available.

12. **Patient Update** – The ADT Patient Registration System informs the Order Placer and the Department System Scheduler/Order Filler of new information for a particular patient. The Department System Scheduler may then further inform the Image Manager.

13. **Procedure Update** – The Department System Scheduler/Order Filler sends the Image Manager updated order or procedure information.

14. **Query Image** – An Image Display provides a set of criteria to select the list of entries representing images by patient, study, series, or instance known by the Image Archive.

15. **Query Presentation State** – An Image Display provides a set of criteria to select the list of entries representing image Grayscale Softcopy Presentation States (GSPS) by patient, study, series, or instance known by the Image Archive.

16. **Retrieve Images** – An Image Display requests and retrieves a particular image or set of images from the Image Archive.

17. **Retrieve Presentation States** – An Image Display requests and retrieves the Grayscale Softcopy Presentation State (GSPS) information for a particular image or image set.

18. **Creator Images Stored** – An Image Creator requests that the Image Archive store new images.

19. **Creator Presentation State Stored** – An Image Creator requests that the Image Archive store the created Grayscale Softcopy Presentation State objects.

20. **Creator Procedure Step In Progress** – An Image Creator notifies the Performed Procedure Step Manager of a new Procedure Step.

21. **Creator Procedure Step Completed** – An Image Creator notifies the Performed Procedure Step Manager of the completion of a Procedure Step.

22. **Creator Storage Commitment** – An Image Creator requests that the Image Manager take responsibility for the specified images and/or GSPS objects that the Creator recently stored.

23. **Print Request with Presentation LUT –** A Printer Composer sends a print request to the Print Server specifying Presentation LUT information.

24. **Report Submission –** A Report Creator sends a draft or final report to the Report Manager.

25. **Report Issuing –** A Report Manager sends a draft or final Report to the Report Repository.

26. **Query Report –** A Report Reader provides a set of criteria to select the list of entries representing reports by patient, study, series, or report known by the Report Repository or External Report Repository Access.

27. **Retrieve Report –** A Report Reader requests and retrieves a report from the Report Repository or External Report Repository Access.

3.3　Grouping of Actors

The actors identified in figure 3-1 may be selected individually or in any combination by product implementations. However, in cases explicitly specified below, the selection of one actor requires an implementation to select one or more additional actors:

1. The Image Archive shall be grouped with the Image Manager and Performed Procedure Step Manager.

2. The Performed Procedure Step Manager shall be grouped with either an Image Manager or a Department System Scheduler.

3. The Print Composer shall be grouped with either an Image Manager, an Acquisition Modality, an Image Display or an Image Creator.

4. The Image Creator shall be grouped with an Image Display. This is a uni-directional requirement – the Image Display does not have to be grouped with any other actor.

5. The Order Filler/Department System Scheduler shall be grouped with the Department System Database and Performed Procedure Step.

When multiple actors are supported by a single product implementation, all transactions originating or terminating with each of the supported actors shall be supported (i.e., the IHE transactions shall be offered on an external product interface). The exceptions to this rule are the transactions defined between actors in the required groupings defined above (some may have no transactions between them) that do not need to be offered on an external interface.

Note:　For example, the Procedure Step In Progress/Completed transaction does not need to be supported between the Performed Procedure Step Manager and the Image manager when these are grouped. On the other hand, the Report Submission Transaction must be supported even by an implementation that groups the Report Creator and the Report Manager Actors.

When two or more actors are grouped together, internal communication between actors is assumed to be sufficient to allow the necessary information flow to support their functionality; for example, the Image Manager provides necessary information updates to the Image Archive to support its Query/Retrieve functionality. The exact mechanisms of such internal communication are outside of the scope of IHE Technical Framework.

3.4　Actor Requirements Overview

The tables below summarize the requirements for each of the actors which are part of the IHE Framework in terms of the transactions they must support. Some of the tables relate to a single actor; others, to groups of actors. In every case, the tables are in line with the grouping rules specified in section 3.3. This set of tables is not intended to include all possible actor groupings but merely a representative subset. Notes provide clarification and reference to applicable sections of the document wherever necessary.

Some tables include the contents of other tables. This inclusion means that the rows and columns of the referenced table (excluding headings) and all tables it includes are prepended to the referencing table. Table inclusion was not used for tables which shared actors (e.g. Image Archive/Image Manager and Image Archive/Image Manager/Performed Procedure Step Manager) but had different requirements for common transactions (e.g. Modality Procedure Step In Progress).

These tables provide a condensed view of actor requirements; for full detail and context of these requirements, read the subsections of section 6.

Table 3.4-1. Acquisition Modality

Transaction	Optionality	Notes
Modality Worklist Provided	Required	Must support patient-based or broad query. See section 6.5
Modality Images Stored	Required	
Modality Storage Commitment	Required	
Modality Procedure Step In Progress	Required	See section 6.6 for Protocol and Procedure code options
Modality Procedure Step Completed	Required	
Modality Presentation State Stored	Optional	

Table 3.4-2. Acquisition Modality/Print Composer

Transaction	Optionality	Notes
Include contents of table 3.4-1 Acquisition Modality		
Print Request with Presentation LUT	Required	

Table 3.4-3. ADT Patient Registration

Transaction	Optionality	Notes
Patient Registration	Required	
Patient Update	Required	

Table 3.4-4. Image Archive/Image Manager/Performed Procedure Step Manager

Transaction	Optionality	Notes
Modality Images Stored	Required	
Modality Presentation State Stored	Required	
Modality Procedure Step In Progress	Required	

Modality Procedure Step Completed	Required	
Modality Storage Commitment	Required	
Creator Images Stored	Required	
Creator Presentation State Stored	Required	
Creator Procedure Step in Progress	Required	
Creator Procedure Step Completed	Required	
Creator Storage Commitment	Required	
Query Images	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCP. May support Patient Root Query/Retrieve - FIND SOP class as SCP. See section 6.14
Query Presentation State	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCP. May support Patient Root Query/Retrieve - FIND SOP class as SCP. See section 6.15
Retrieve Images	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCP. May support Patient Root Query/Retrieve - MOVE SOP class as SCP. See section 6.16
Retrieve Presentation State	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCP. May support Patient Root Query/Retrieve - MOVE SOP class as SCP. See section 6.17
Procedure Scheduled	Required	
Image Availability Query	Required	
Patient Update	Required	
Procedure Update	Required	

Table 3.4-5. Image Archive/Image Manager/Performed Procedure Step Manager/Print Composer

Transaction	Optionality	Notes
Include contents of table 3.4-4 Image Archive/Image Manager/Performed Procedure Step Manager		
Print Request with Presentation LUT	Required	

Table 3.4-6. Department System Scheduler/Order Filler/Department System Database/Performed Procedure Step Manager

Transaction	Optionality	Notes
New Order	Required	
Order Cancel	Required	
Modality Worklist Provided	Required	Must support patient-based or broad query. See section 6.5

Modality Procedure Step In Progress	Required	
Modality Procedure Step Completed	Required	
Creator Procedure Step in Progress	Required	
Creator Procedure Step Completed	Required	
Image Availability Query	Required	
Patient Registration	Required	
Patient Update	Required	
Procedure Scheduled	Required	
Procedure Update	Required	

Table 3.4-7. Image Display

Transaction	Optionality	Notes
Query Images	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCU. May support Patient Root Query/Retrieve - FIND SOP class as SCU. See section 6.14
Query Presentation State	Optional	
Retrieve Images	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCU. May support Patient Root Query/Retrieve - MOVE SOP class as SCU. See section 6.16
Retrieve Presentation State	Optional	

Table 3.4-8. Image Display/Image Creator

Transaction	Optionality	Notes
Include contents of table 3.4-7 Image Display		
Creator Images Stored	Required	Must support Image Storage or GSPS Storage or both as SCU
Creator Presentation State Stored	Required	
Creator Storage Commitment	Required	
Creator Procedure Step in Progress	Optional	
Creator Procedure Step Completed	Optional	

Table 3.4-9. Image Display/Image Creator/Print Composer

Transaction	Optionality	Notes

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Include contents of table 3.4-8 Image Display/Image Creator		
Print Request with Presentation LUT	Required	

Table 3.4-10. External Report Repository Access

Transaction	Optionality	Notes
Query Report	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCP. May support Patient Root Query/Retrieve - FIND SOP class as SCP. See section 6.26
Retrieve Report	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCU. May support Patient Root Query/Retrieve - MOVE SOP class as SCU. Must support Basic Text SR Storage SOP class as SCU. May support Enhanced SR Storage SOP class as SCU. See section 6.27

Table 3.4-11. Order Placer

Transaction	Optionality	Notes
Patient Registration	Required	
New Order	Required	
Order Cancel	Required	
Patient Update	Required	

Table 3.4-12. Print Server

Transaction	Optionality	Notes
Print Request with Presentation LUT	Required	

Table 3.4-13. Report Creator

Transaction	Optionality	Notes
Report Submission	Required	Must support Basic Text SR Storage SOP class Enhanced SR Storage SOP class or both as SCU. See section 6.24

Table 3.4-14. Report Manager

Transaction	Optionality	Notes
Report Issuing	Required	Must support Basic Text SR Storage SOP class as SCU. If Enhanced SR Storage SOP class is supported as SCP for Report Submission transaction then must support Enhanced SR Storage SOP class as SCU. Otherwise, may support Enhanced SR Storage SOP class as SCU. See section 6.24
Report Submission	Required	Must support Basic Text SR Storage SOP class as SCP. May support Enhanced SR Storage SOP class as SCP. See section 6.25.

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Table 3.4-15. Report Reader

Transaction	Optionality	Notes
Query Report	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCU. May support Patient Root Query/Retrieve - FIND SOP class as SCU. See section 6.26
Retrieve Report	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCU. May support Patient Root Query/Retrieve - MOVE SOP class as SCU. Must support Basic Text SR Storage SOP class as SCP. May support Enhanced SR Storage SOP class as SCP. See section 6.27

Table 3.4-16. Report Repository

Transaction	Optionality	Notes
Report Issuing	Required	Must support both Basic Text SR Storage SOP class and Enhanced SR Storage SOP class as SCP. See section 6.24
Query Report	Required	Must support Study Root Query/Retrieve - FIND SOP class as SCU. May support Patient Root Query/Retrieve - FIND SOP class as SCU. See section 6.26
Retrieve Report	Required	Must support Study Root Query/Retrieve - MOVE SOP class as SCU. May support Patient Root Query/Retrieve - MOVE SOP class as SCU. Must support both Basic Text SR Storage SOP class and Enhanced SR Storage SOP class as SCU. See section 6.27

4 The IHE Data Model

4.1 Scope

This section defines the integrated data model adopted by the IHE Technical Framework for the HL7 messages and the DICOM Information Object Definitions (IODs). The Entity Relationship (ER) diagram represents the integration of proper subsets of HL7 2.3.1 and the DICOM Model of the Real World with minor extensions as noted in section 1 and described in appendix B.

4.2 Model of the Real World

Figure 4.2-1 depicts the model of real world within scope of the IHE Technical Framework: Year 2. This model provides an overview of the high-level integration of the DICOM and HL7 models. This integrated model differs from the DICOM Model of the Real World (refer to DICOM 1999 PS 3.3) in the following aspects:

- The Service Episode, Procedure Plan and Procedure Type entities as well as the relationship between the Visit and Imaging Service Request have been excluded; these entities and relationships are outside the scope of the IHE Technical Framework: Year 2.

- The HL7 Placer Order entity has been inserted into the DICOM hierarchy between the Patient entity and Imaging Service Request Entity.

- The DICOM Imaging Service Request Entity is equated with the HL7 Filler Order entity. In this relationship IHE provides clarification of the use of the Accession Number - DICOM attribute (0008,0050); see appendix A for further discussion.

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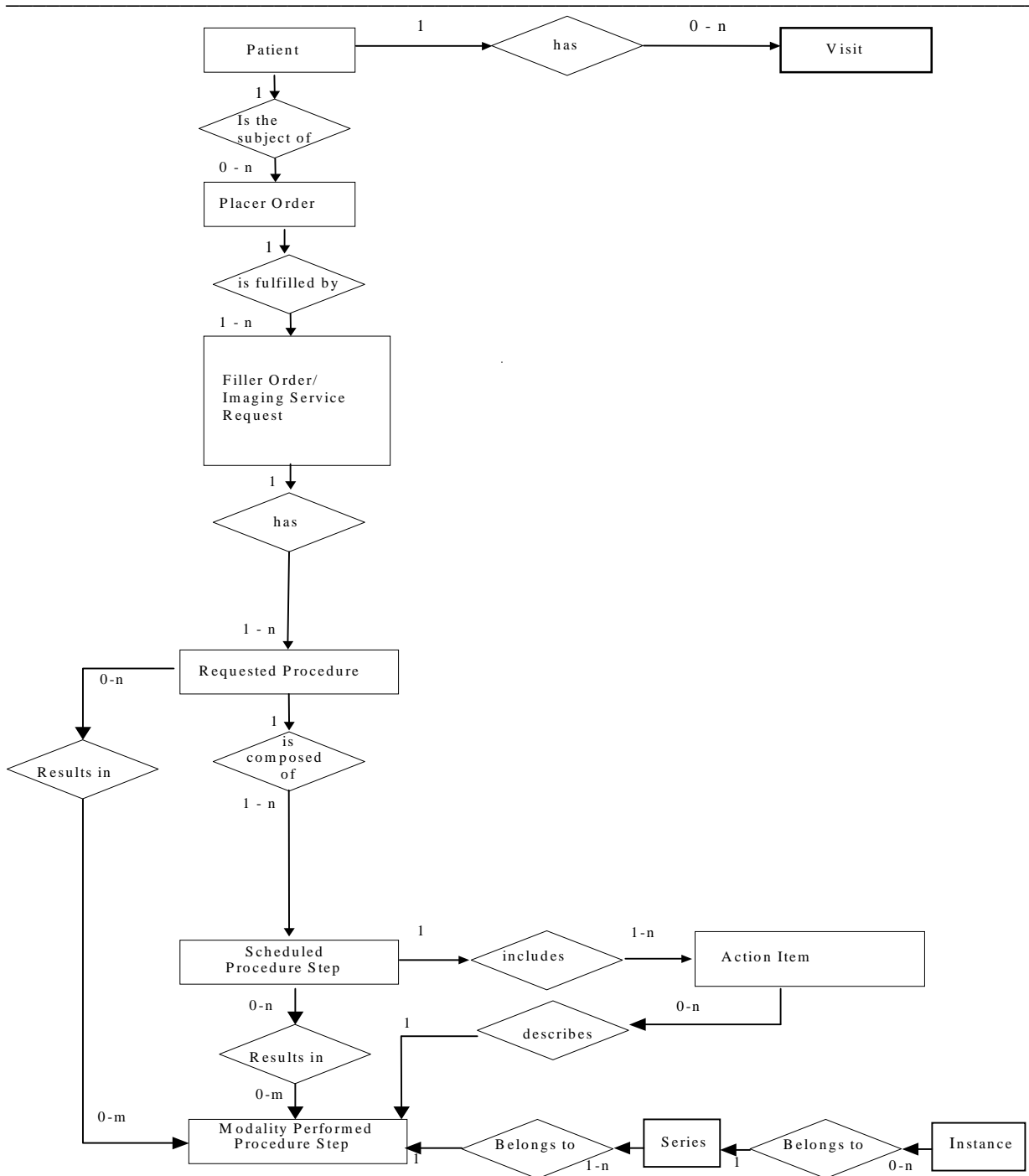
Figure 4.2-1: Model of the Real World for IHE Integrated Information

4.3   The IHE Information Model

The IHE Information Model is represented in this section as an Entity Relationship (ER) diagram. The IHE Information Model is based on the DICOM and HL7 standards. The keys

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relating the entities and the unique keys of each entity are defined and the cardinality of the entities is indicated.

An example of the conventions used to specify an entity's relationship is given in figure 4.3-2.

Entity Name
Foreign Key (FK) relating this entity to previous - The FK is shown to clarify the ER diagram and not intended to represent a relational model.
Unique Key (U) for this entity. There are cases where Unique keys that are identical within the scope of this document have different contextual meanings, as defined in this document. The "+" symbol indicates two attributes must be combined to guarantee uniqueness.

Figure 4.3-2. Example of the Entity Relationship Diagram
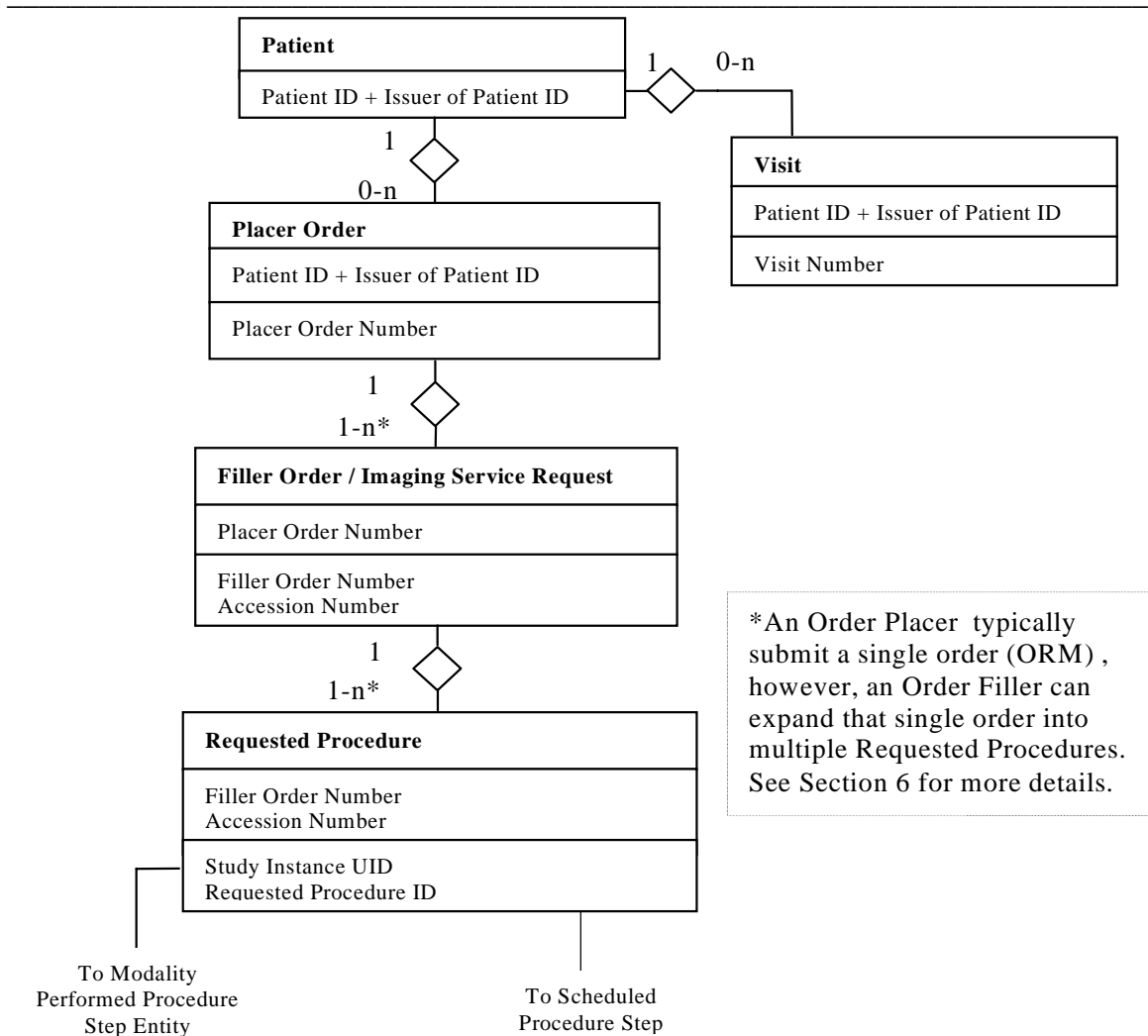
Figure 4.3-3. IHE Information Model (part 1)

Figure 4.3-3 contains the overview of the IHE Information Model. See section 2 of this document for HL7 and DICOM mapping considerations. Mappings between specific HL7 Elements and DICOM Attributes are identified in appendix D.

From Requested Procedure Step

1

1-n

Scheduled Procedure Step

Requested Procedure ID
Study Instance UID

Scheduled Procedure Step ID

0-n**

0-n**

0-m**

0-m**

Modality Performed Procedure Step

Scheduled Procedure Step ID
Study Instance UID

Performed Procedure Step UID***
Affected SOP Instance UID

1

1-n

Series

Performed Procedure Step UID***

Series Instance UID

**See Section 6 for a thorough description of the cardinality relationship options of Modality Performed Procedure Step.
***The Performed Procedure Step UID is present as the Affected SOP Instance UID.

1

0-n

DICOM Instance

Series Instance UID

SOP Instance UID

Figure 4.3-3. IHE Information Model (part 2)

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5   Enterprise Process Flows

This section describes typical examples of the process and information flows of patient care in healthcare enterprise. Examples are used to highlight the principles and strategies adopted by the IHE Technical Framework and are not intended to provide an exhaustive set of supported process and workflow patterns. The examples consider the use of a single instance of each actor whereas real-life situations might require multiple instances of some actors.

Process Flow diagrams shown in subsequent sections illustrate the flow of processes and interactions among the actors involved in a particular example. These diagrams are constructed similar to those for interaction diagrams (see section 2 and figure. 5-1).

Note: The Performed Procedure Step Manager is not shown on the Process Flow diagrams and is presumed to be grouped with the Image Manager. It may be grouped with the Department System Scheduler/Order Filler with corresponding changes in the flow of PPS related transactions between the Image Manager and Department System Scheduler/Order Filler.
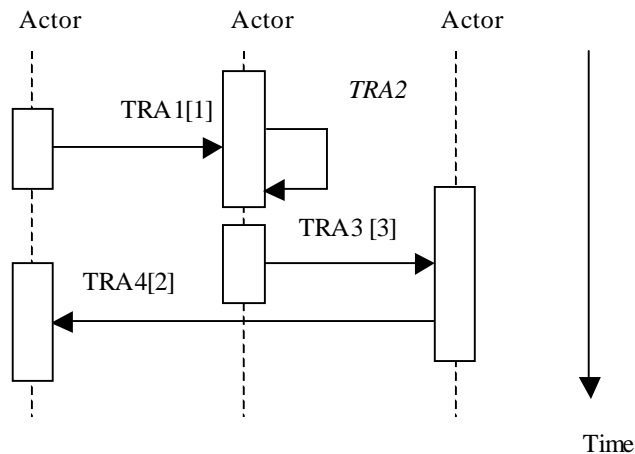
Figure 5-1. Example of Process Flow Diagram

Note 1: The actors involved are displayed on the vertical axes. The vertical axis identifies the timeline with time increasing from the top of the axis downward.

Note 2: An arrow between two actors identifies a transaction. Transaction names above the arrows are followed (in the square brackets) by transaction numbers outlined in section 3.3.

Note 3: Names printed in italics indicate internal processes that do not have an IHE defined transaction associated with them.

5.1   Typical Process Flow

This section describes process and information flow of the patient care as it is defined in the IHE Technical Framework: Year 2 under "normal" circumstances. It covers transactions 1 through 13

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and transaction 23 which reflect typical patient encounter from the registration/admission through the performance of an ordered procedure. See appendix F for the overview of the information exchange between DSS/Order Filler and Image Manager.

5.1.1 Administration and Procedure Performance Process Flow

This case covers both inpatient and outpatient procedures. The patient may be new or known to the current healthcare facility. The following sequence of steps describes the typical process flow when a procedure is requested to be performed on a patient.
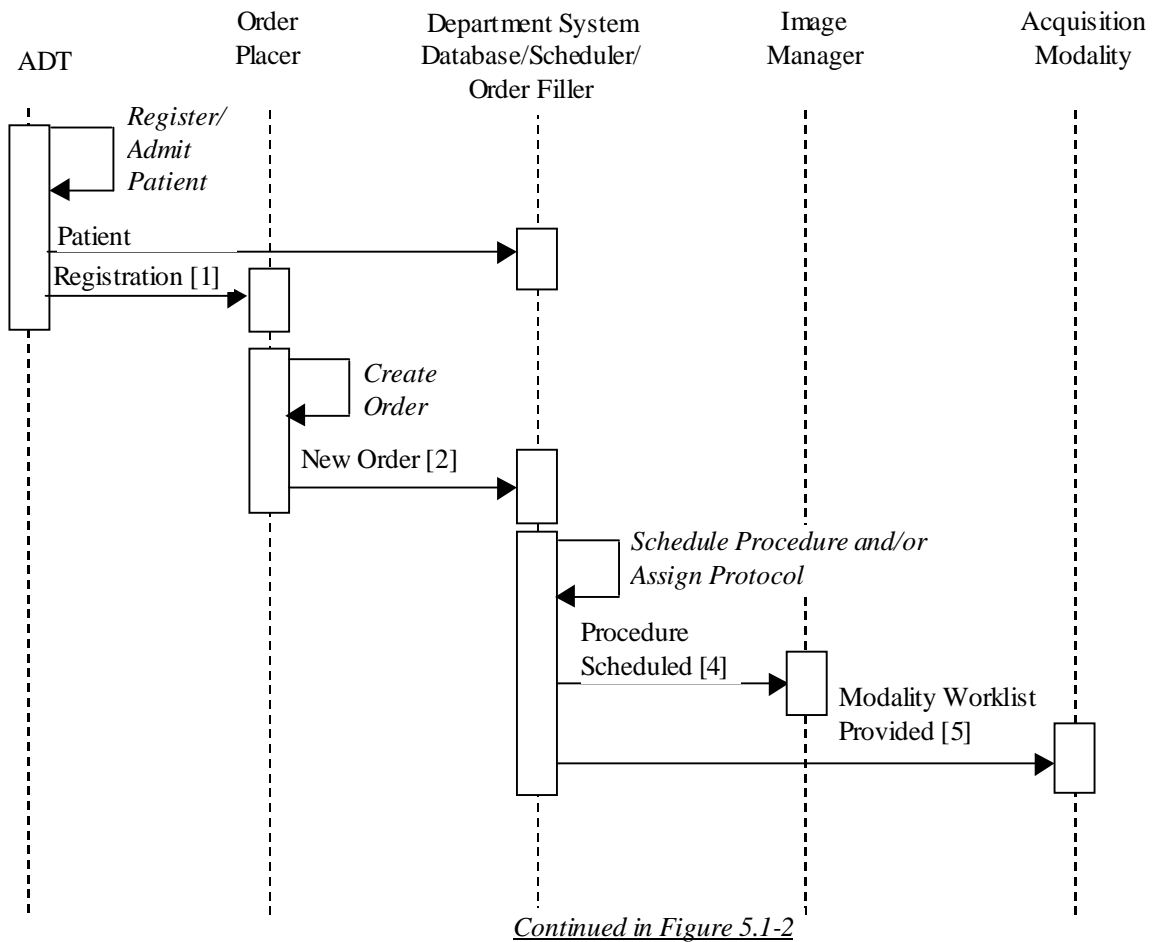
Figure 5.1-1. Administrative Process Flow
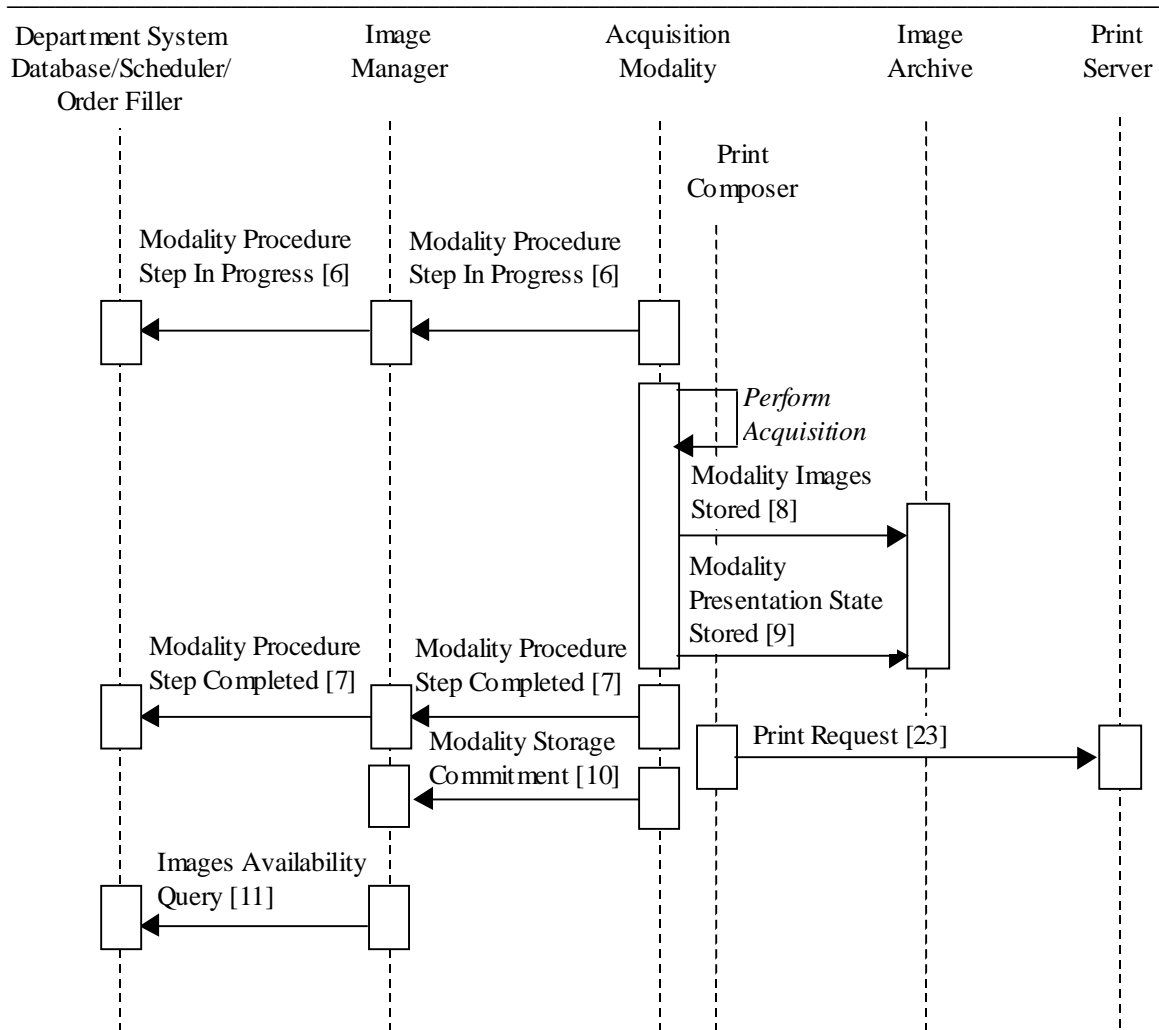
Figure 5.1-2. Procedure Performance Process Flow

The following should be noted in relation to the Administrative and Procedure Performance process flow:

- The Print Composer is grouped with an Acquisition Modality but is shown separately in the diagram to distinguish the different transactions.

- *Schedule Procedure*. The order is associated with a number of procedures that have to be performed to satisfy the order. Each procedure prescribes a number of action items that have to be performed by the Acquisition Modality. Action items may be grouped into Scheduled Procedure Steps based on the timing and ordering. Scheduled Procedure Steps are scheduled, i.e., assigned a time slot and performing resource (modality).

- *Protocol Assigned*. The radiologist determines the protocol, i.e., settings and conditions to be used in performing procedure steps. This may happen before, simultaneously with or subsequent to the *Schedule Procedure* process step.

- The diagram above shows one particular sequencing of the Performed Procedure Step "Completed" transaction. This transaction may occur at any point after image and/or

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GSPS creation. This means it can occur before images and/or GSPS are stored, after storage, after printing as in this example, or even after storage commitment. The IHE Technical Framework does not specify the timing of this transaction in relation to other transactions.

5.1.2   Patient Update Flow

This case covers the situation when patient information updates are introduced into the system at the different stages of the normal process flow. Such updates will cause additional transactions to occur to assure synchronization of information between interested actors. Only the affected parts of the normal flow diagram are presented below. All subsequent process steps will progress according to the normal flow diagram.

5.1.2.1   Patient Update Before Procedure Scheduling

If patient information is changed before the corresponding procedure(s) are scheduled by the DSS/Order Filler, the Patient Registration steps are altered as presented in the figures 5.1-3 and 5.1-4.
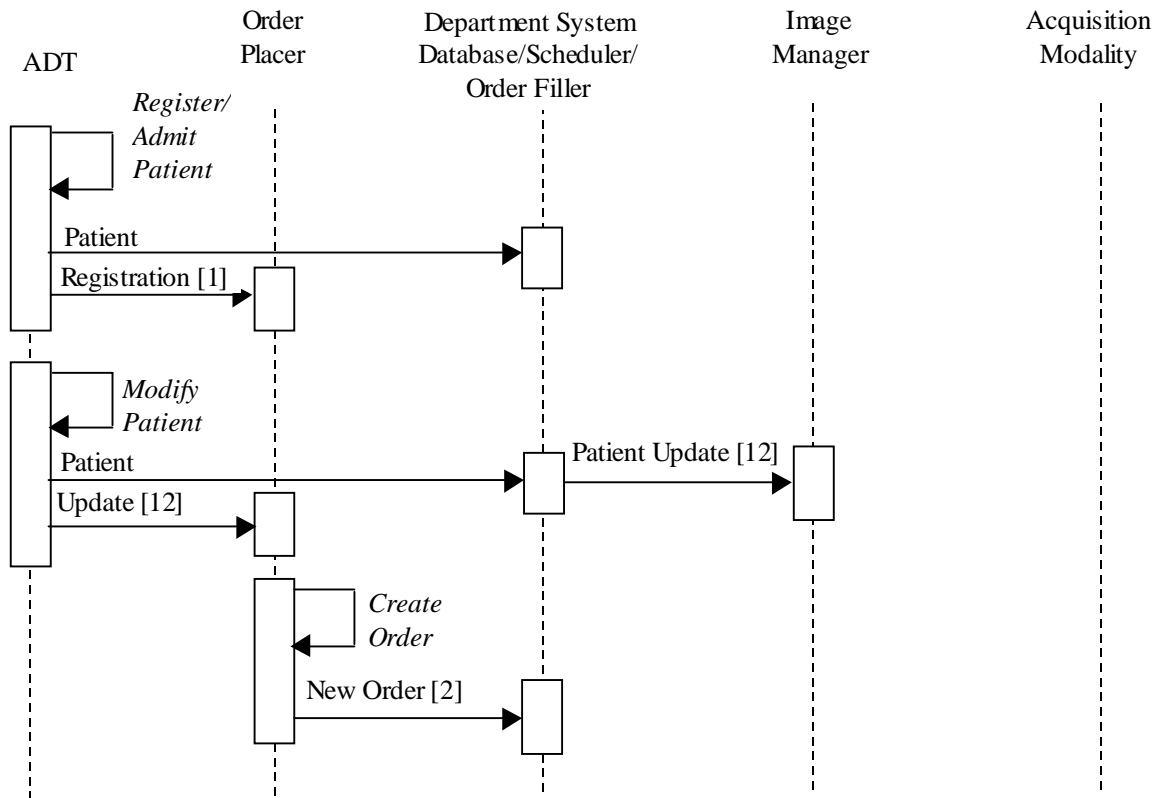
Figure 5.1-3. Patient Update before Order Entry

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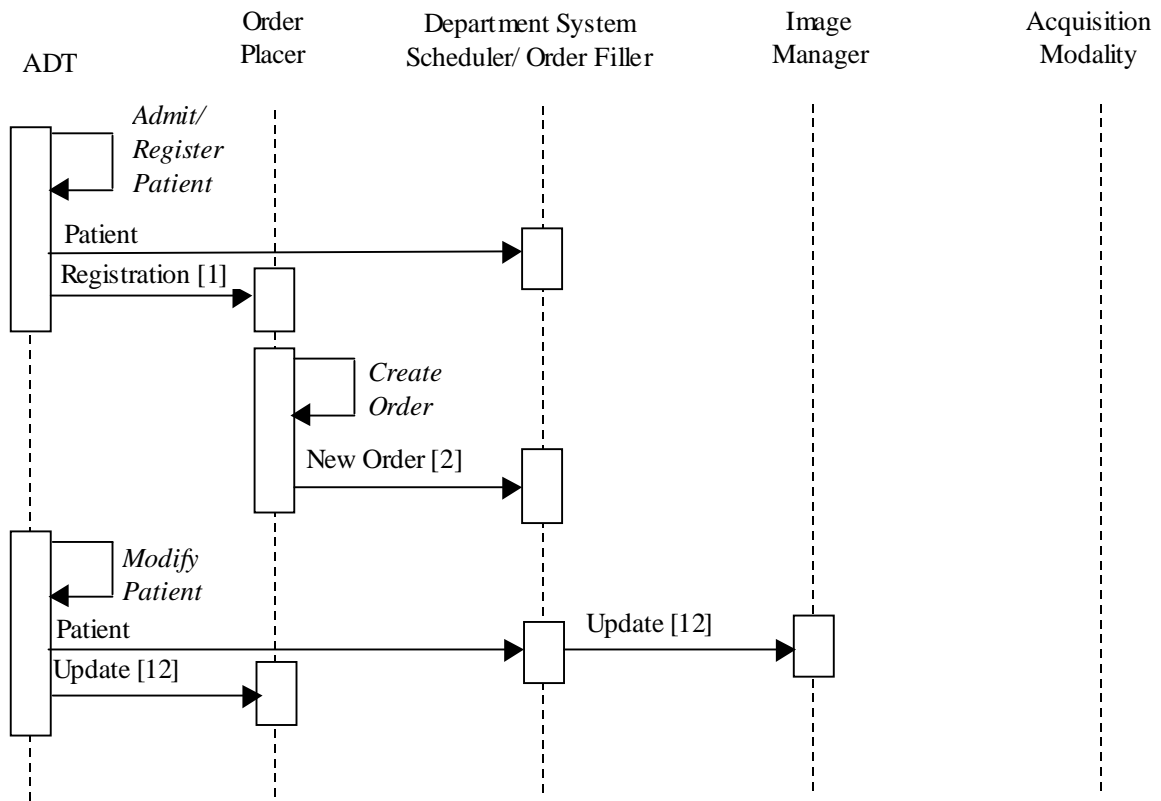
Figure 5.1-4. Patient Update after Order Entry

The *Modify Patient* process includes changing inpatient demographics, merging two patient records and moving the information from one patient record to another.

5.1.2.2 Patient Update After Procedure Scheduling

If patient information is changed after procedure(s) are scheduled by the Order Filler, the Patient transactions altered as follows:

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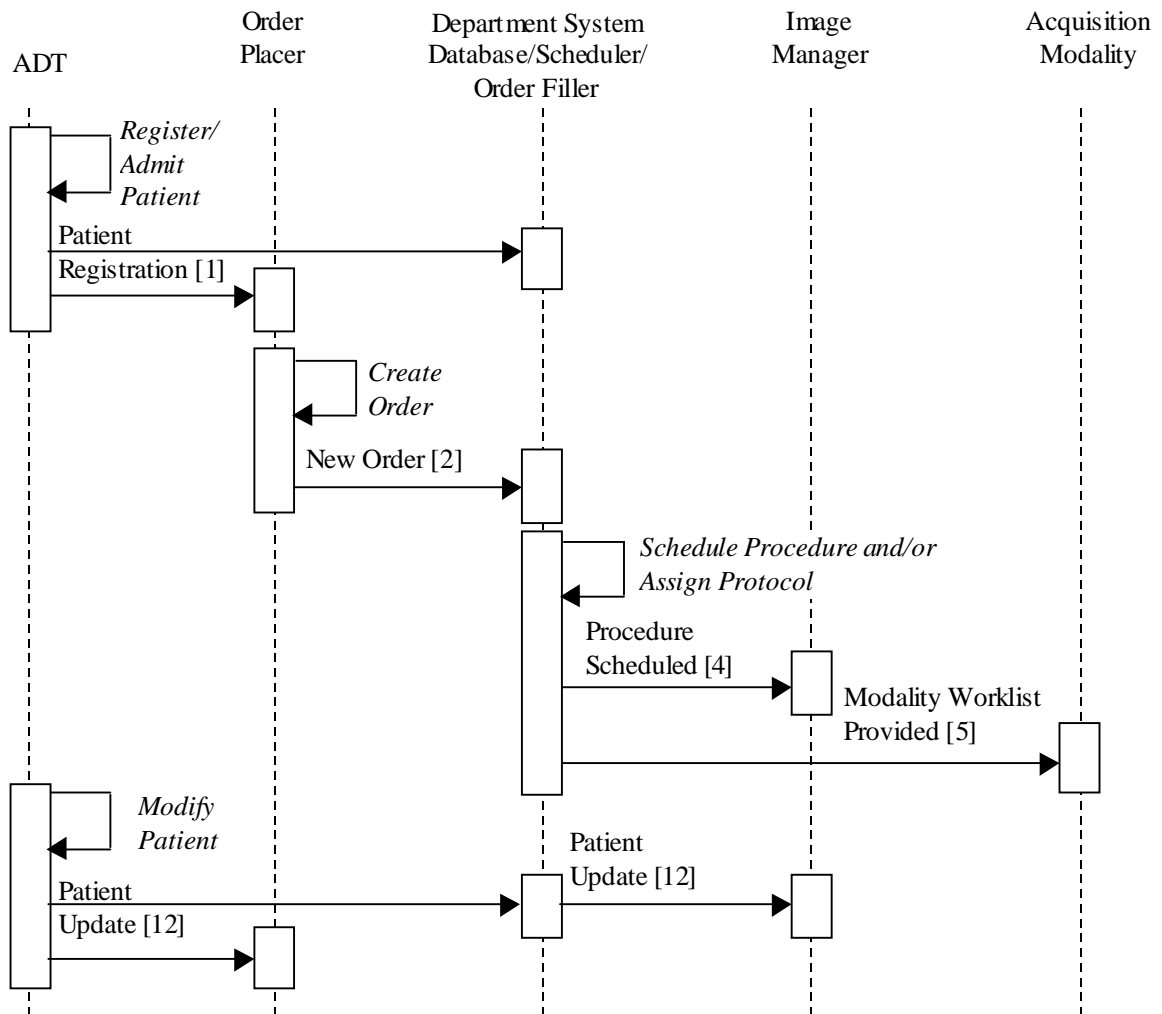
Figure 5.1-5. Patient Update After Procedure Scheduling

In addition to the information exchange between ADT, Order Placer and DSS/Order Filler actors, Patient Update information is also sent to the Image Manager. It is the responsibility of the Image Manager to ensure that the patient information is updated in the images and Grayscale Softcopy Presentation State objects when they are retrieved from the Image Archive.

5.1.3 Order Change Flow

This case covers the situation when the Order Placer or the DSS/Order Filler has to change order information or cancel/discontinue an order. When order information change is necessary, IHE Technical Framework: Year 2 requires the initiating actor to cancel the order and generate the new one using the new information. figures 5.1-6 and 5.1-7 depict examples of order cancellation/re-ordering flow initiated by the Order Placer and the DSS/Order Filler respectively. Note that one should consider these transactions as being performed between the process flow fragments depicted in the figures 5.1-1 and 5.1-2 to ensure synchronization of information between interested actors.
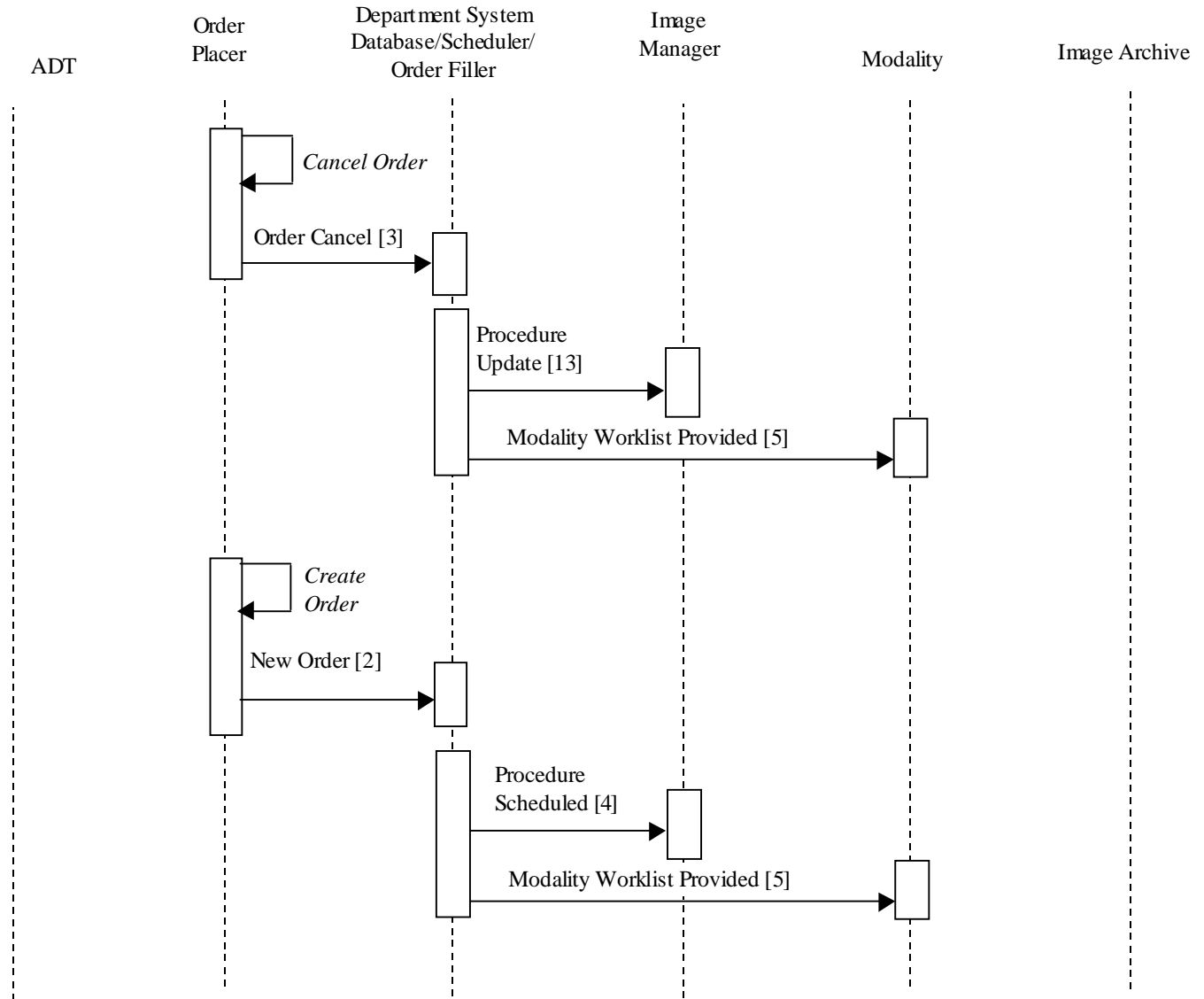
Figure 5.1-6. Order Replacement by the Order Placer

DSS/Order Filler may cancel an order received from the Order Placer and place the new order as a replacement, as shown in the figure 5.1-7.

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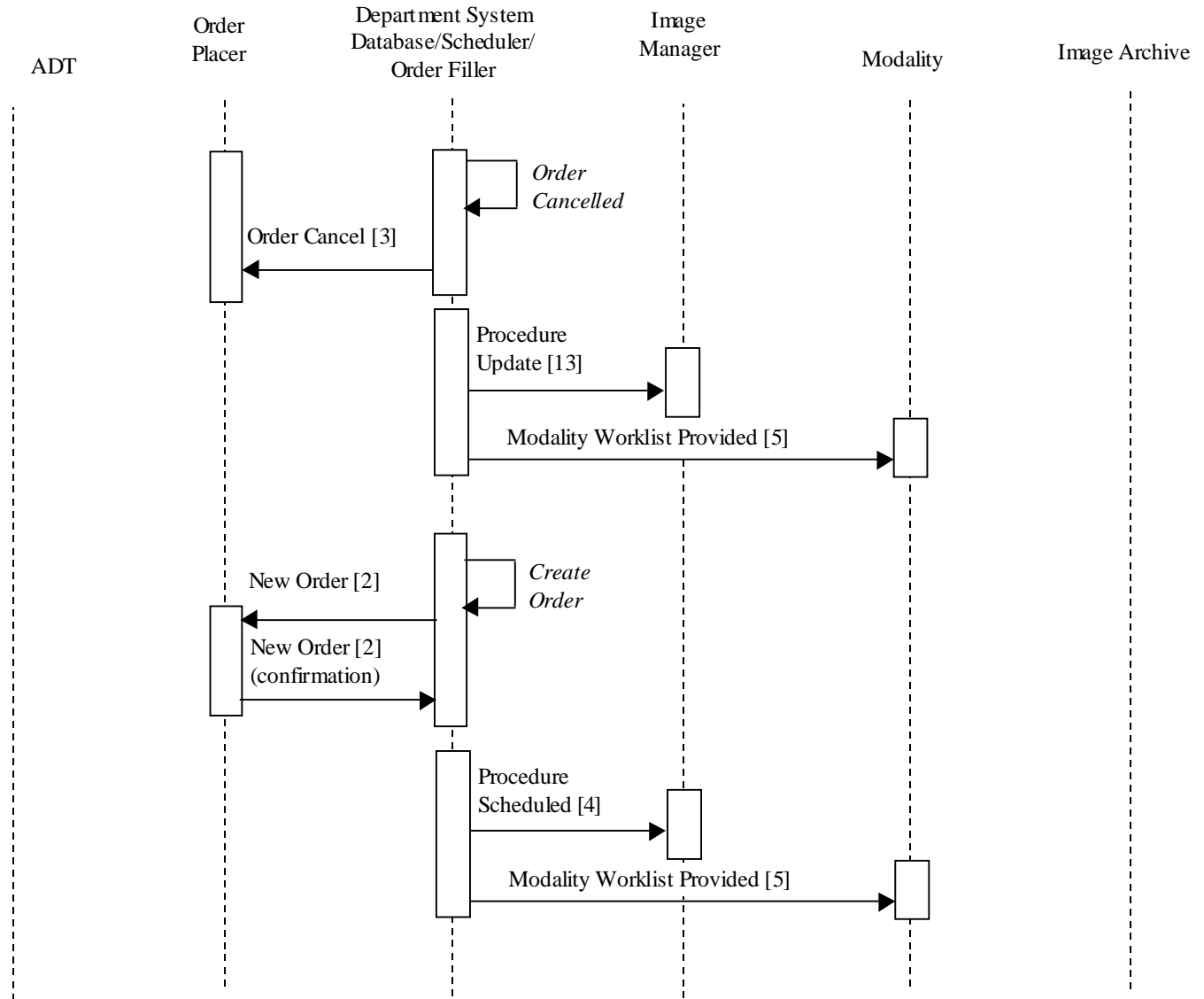
Figure 5.1-7. Order Replacement by the DSS/Order Filler

The DSS/Order Filler may also generate a new order on its own as a means of handling the unidentified patient case discussed in section 5.4. The process flow in such situation corresponds to the ordering sequence in figure 5.1-7, without the preceding Order Cancel transaction.

>   **Note:** The IHE Technical Framework: Year 2 does not support notification of the modality of the order discontinuation after the Modality Procedure Step In Progress message has been generated by the Acquisition Modality, i.e., the current procedure step will be completed even though the order could be discontinued.

5.2   Enterprise Access and Creation of Imaging Information

This section describes the typical process flow related to viewing images with Grayscale Softcopy Presentation States and performing image post-processing that may generate new images and/or Grayscale Softcopy Presentation States. The transactions covered are 14 through 22.

5.2.1   Scope

Enterprise Access to Imaging Information is an integration feature that provides access to images with their full fidelity content as they were acquired or created. Such access is available either:

- Internally to the source imaging department;
- Between imaging departments (e.g., Cardiology and Radiology); or
- Throughout the Healthcare Enterprise to other departments or care providers other than an imaging department (e.g., Surgery, Neurology, Oncology).

Enterprise Access to Imaging Information enables advanced review as well as simple or sophisticated post-processing of images along with related objects (such as Grayscale Softcopy Presentation States, or Structured Reports) in a variety of clinical scenarios. Examples are:

- Based on patient identifying information, a clinician wishes to look for imaging studies performed on this patient. The clinician may access one or more series of images, related to a recent examination;
- A radiologist performing a primary or secondary read wishes to retain viewing parameters including clinical annotations;
- A clinician reviewing a report that references key images wishes to review these images;
- A technologist about to perform an imaging examination wishes to retrieve a prior imaging examination for ensuring consistent patient positioning;
- A radiologist interpreting a study wishes to perform a comparison with images acquired in a prior study. The radiologist also needs to review the images as they were presented when a prior diagnosis was prepared;
- A surgeon creates a 3D volume analysis of an image set to plan surgery on a patient.

5.2.2   Consistent Presentation of Images

The appearance of grayscale images displayed on different types of softcopy display devices or printed by different types of hardcopy output devices has often been inconsistent. To address this problem and achieve consistent presentation of grayscale images the DICOM Standard defines:

- A standard curve, the Grayscale Standard Display Function, against which different types of display and hardcopy output devices should be calibrated;
- Basic Print Management with Presentation Look Up Table, for controlling the consistent appearance of preformatted images on printed output;
- Grayscale Softcopy Presentation State, an object for storing and communicating the parameters that describe how an image or set of images should be displayed. A Grayscale

Softcopy Presentation State object contains references to the images it applies to, and the transformations (grayscale transformations, shutter transformations, image annotation, spatial transformations, and display area annotation) that should be applied when the images are presented on a softcopy display.

These capabilities are supported by the IHE Technical Framework. Their typical use is depicted in figure 5.2-1. Another use case is described in section 5.5.
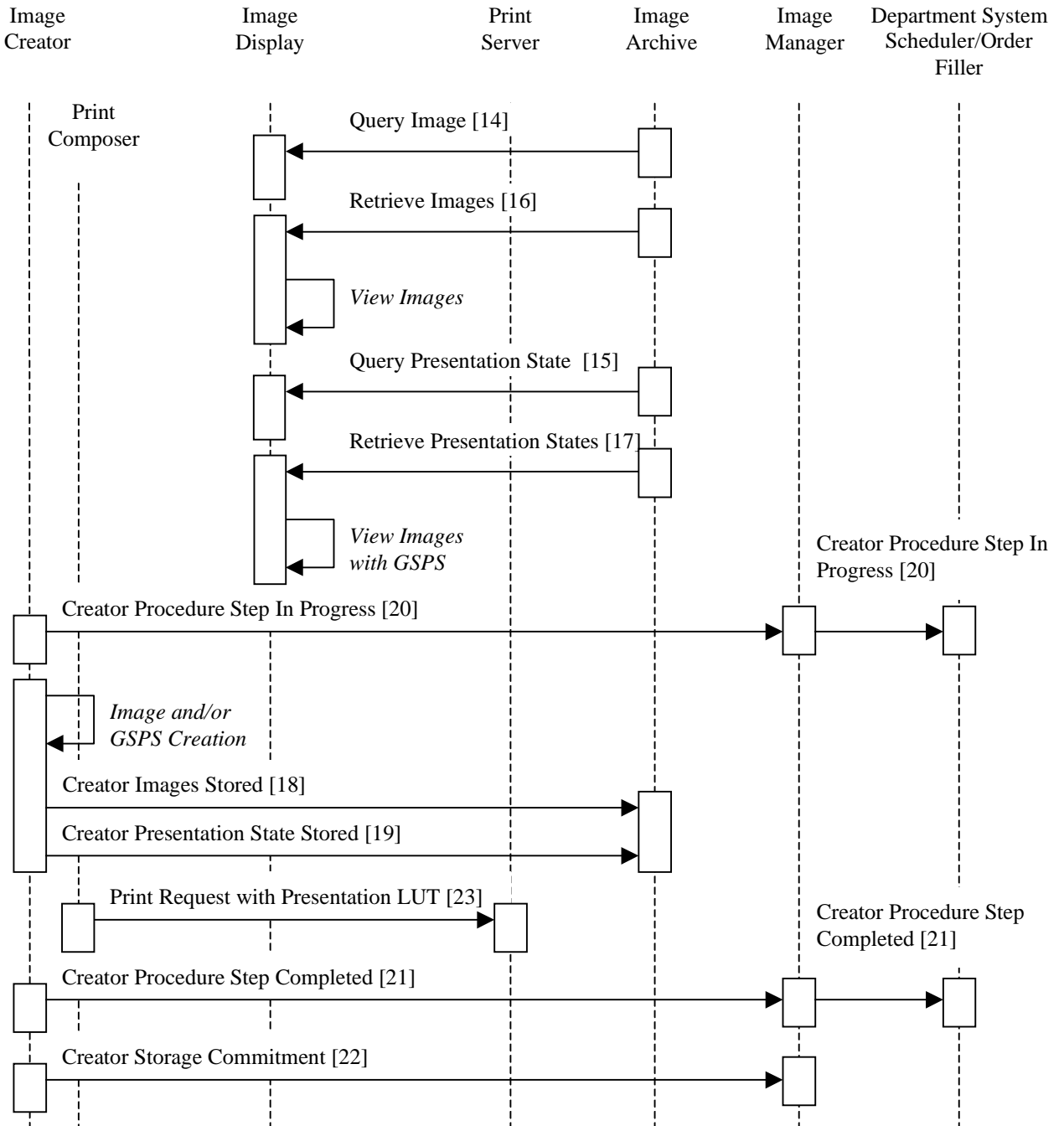
Figure 5.2-1. Enterprise Access and Creation of Imaging Information Process Flow

The following shall be taken into account in relation to the Enterprise Access and Creation of Imaging Information Flow:

- The Image Creator Actor shall be grouped with an Image Display Actor but is shown separately in the diagram above to distinguish the transactions;

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- In this example, the Print Composer Actor is grouped with the Image Creator Actor but may be grouped with other actors that have access to images;

- The diagram above shows one particular sequencing of the Performed Procedure Step "Completed" transaction. This transaction may occur at any point after image and/or GSPS creation. This means it can occur before images and/or GSPS are stored, after storage, after printing as in this example, or even after storage commitment. The IHE Technical Framework does not specify the timing of this transaction in relation to other transactions.

5.3 Diagnostic Reporting

This section describes the typical process flow related to diagnostic reporting. The transactions covered are 24 through 27.

5.3.1 Scope

In the initial stage of diagnostic reporting, the diagnosis by the Radiologist is used to generate a DICOM Structured Report object which is submitted to the Report Manager. Once a report is sent to the Report Manager, the Report Creator relinquishes control of the report to the Report Manager.

Reports are processed and modified by the Report Manager. This involves adding and changing report data as well as verifying draft reports. In all cases, any change by the Report Manager leads to the creation of a new DICOM Structured Report object. At any time, the Report Manager can transmit reports to the Report Repository for external access, but at a minimum the final report must be sent to the Report Repository.

The Report Repository provides permanent storage of DICOM Structured Reports. It also allows reports to be queried and retrieved throughout the enterprise by Report Readers. A Report Reader provides a user interface to view DICOM Structured Reports that it retrieves from the Report Repository or External Report Repository Access.

The External Report Repository Access is a "gateway" to obtain other enterprise department reports, such as Laboratory and Pathology, from within the Radiology department. DICOM Structured Reports are queried and retrieved by a Report Reader from the External Report Repository Access.
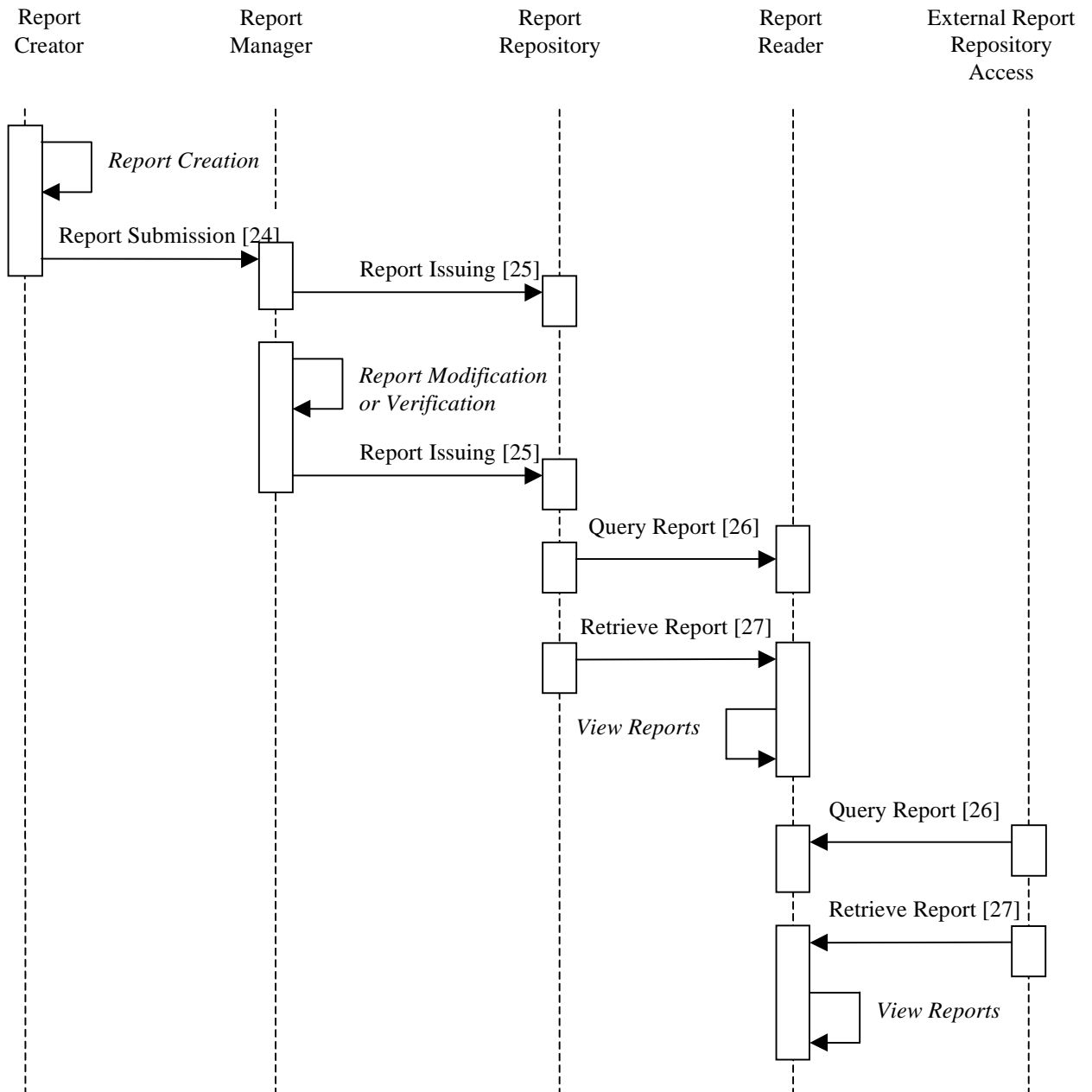
Figure 5.3-1. Diagnostic Reporting Process Flow

5.3.2 Diagnostic Reporting Use Cases

DICOM Structured Reports offer the capability to encode diagonstic report data structured in an arbitrary way. The IHE Technical Framework stipulates that the reporting actors need to support several use cases and their specific content patterns, which are detailed in the following sections. The diagrams in the sections define the report content pattern and utilize the following conventions:

- Each rectangle is a single Content Item.
- Bold text in a rectangle denotes the Code Meaning from the Concept Name Code Sequence.
- Italic text in a rectangle denotes a generic grouping of Concept Names to be used for the Content Item. These must be configurable in the reporting actors.
- Uppercase text in a rectangle denotes the Content Item Value Type.
- Text following the Content Item Value Type specifies the possible Content Item Value(s), if known (only used for Observation Context).
- Text on lines defines the relationship between Content Items.
- Numbers on lines defines the cardinality of descendent Content Items.

5.3.2.1 Key Image Note

The Key Image Note allows the association of a textual description with a list of image references. This content pattern is shown in figure 5.3-2 and shall use the DICOM Basic Text SR Information Object Definition.
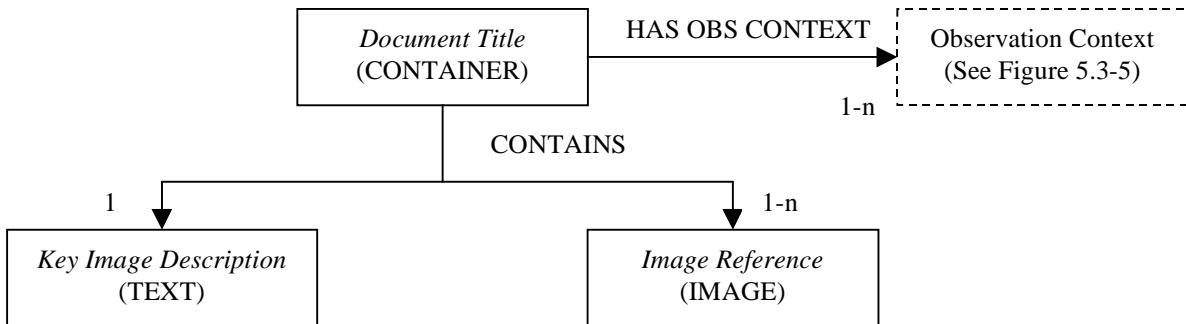
Figure 5.3-2. Key Image Note Pattern

5.3.2.2   **Simple Image Report**

The Simple Image Report allows documents with multiple sections (with headings) containing report text and references to relevant images. Some text items of these documents may also be related to specific images. This allows a radiologist to identify one or more images from which their conclusions were inferred. This content pattern is shown in figure 5.3-3 and shall use the DICOM Basic Text SR Information Object Definition.
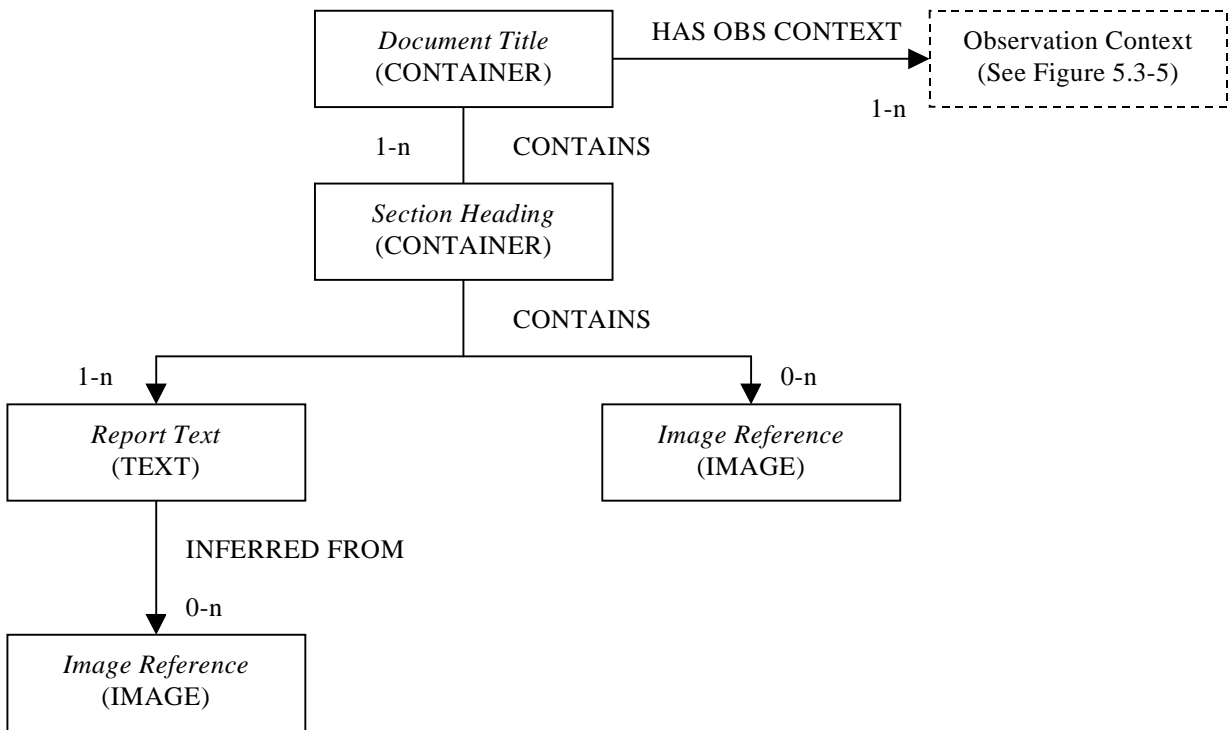
Figure 5.3-3. Simple Image Report Pattern

5.3.2.3 Simple Image and Numeric Report

The Simple Image and Numeric Report is similar to the Simple Image Report described in section 5.3.2.2 but allows the addition of numeric values. This enables a diagnosis to include measurements and other numeric values. Like the Simple Image Report, particular text values can be encoded to signify that they are inferred from specific images or numeric values. The Simple Image and Numeric Report pattern is shown in figure 5.3-4 and shall use the DICOM Enhanced SR Information Object Definition.
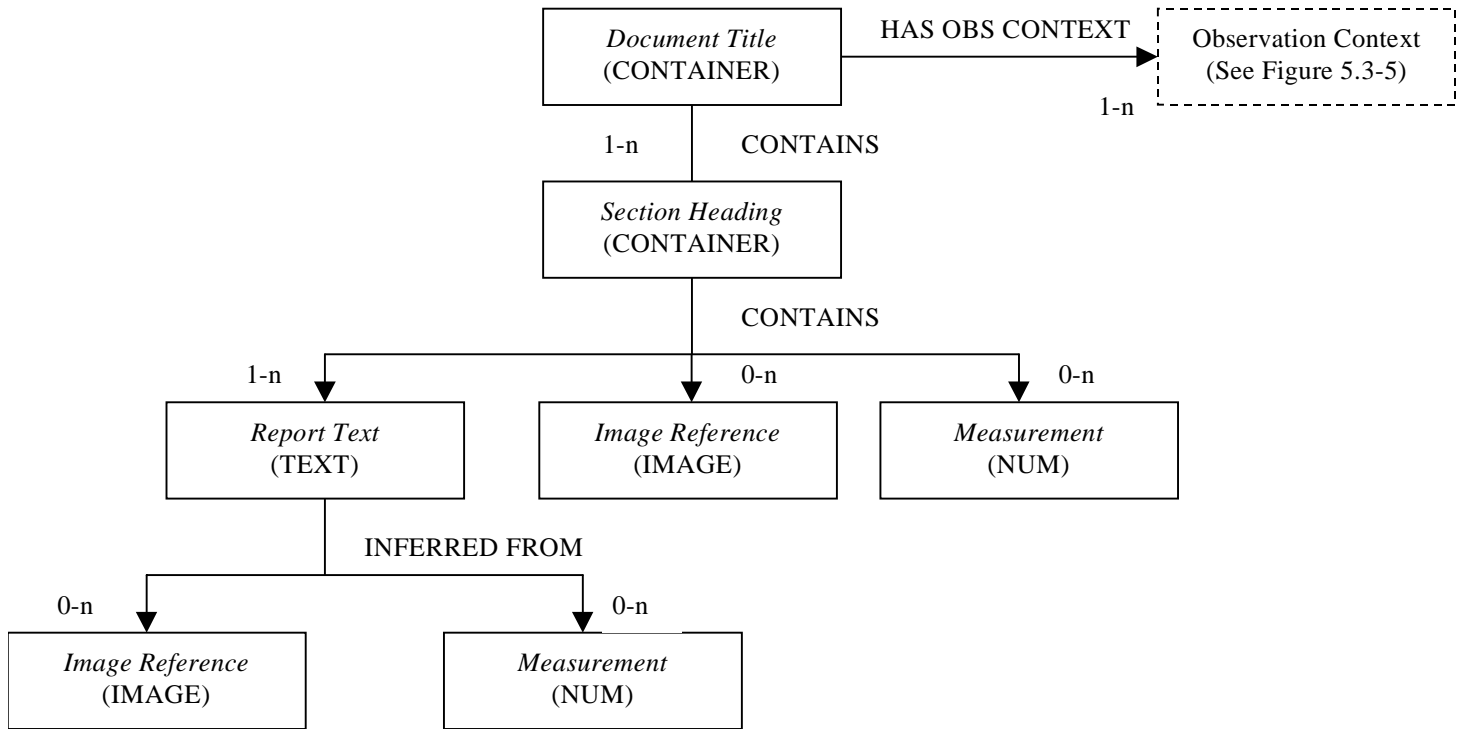
Figure 5.3-4. Simple Image and Numeric Report Pattern

5.3.2.4   Observation Context

For each of the preceding report patterns, observation context shall be included according to the pattern shown in figure 5.3-5. This list of content items specify such information as the type of observation (only "DIRECT" is allowed), the name of the recording observer and their organization, the name of the patient, and links to the procedure that is being reported upon.

Observation context content items shall only be descended from the root content item, and this observation context is inherited by all other nodes descended from the root node. Therefore, the observation context shall not change thoughout the report.

```
┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
  *Document Title*
  (CONTAINER)
└ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
```

HAS OBS CONTEXT

1	1	0-1
Observation Context Mode (CODE = "DIRECT")	**Recording Observer's Name** (PNAME)	**Recording Observer's Organization Name** (TEXT)

0-n	0-1	0-1
Study Instance UID of Evidence Directly Examined by RO (UIDREF)	**HL7 Placer Number of Evidence-Source Procedure** (TEXT)	**HL7 Filler Number of Evidence-Source Procedure** (TEXT)

1	0-1*
Observation Subject Class (CODE = "Patient" or "Fetus")	**Patient-Data-Acquisition Subject** (PNAME)
	Mother of fetus (PNAME) 0-1*

* - "Patient-Data-Acquisition Subject" and "Mother of fetus" are mutually exclusive based on the value of "Observation Subject Class" and one and only one item shall appear

Figure 5.3-5. Observation Context Pattern

5.4 Unidentified Patient Image Acquistion & Reconciliation

This section describes the general process flow related to the handling of procedures for unidentified patients. The transactions covered are 1, 2, 4, 5, 6, 7, 12, and 13.

5.4.1 Scope

The Unidentified Patient case covers the trauma case or emergency room patient when a patient's condition requires that a procedure is conducted immediately. This is done before

proper patient registration, ordering and/or scheduling of the procedure is performed (due to the lack of either information or time or other deviation from the normal process flow). In this case patient/study information must be later reconciled and properly updated at the ADT, Order Placer, DSS/Order Filler and Image Manager. There are several examples of information flow in this case. These examples are described in use cases (see sections 5.4.2.1 – 5.4.2.3 for details):

- Case 1: Unidentified Patient registered at ADT and ordered at Order Placer.
- Case 2: Unidentified Patient registered at ADT and ordered at DSS/Order Filler.
- Case 3: Unidentified Patient registered at ADT but acquisition completed at Modality prior to order.

In cases 1, 2, and 3, the ADT may utilize the Master Patient Index (MPI) internally. The interaction of the ADT with MPI to resolve the patient information to the correct Patient ID may be embedded in the process of patient information reconciliation within the ADT role. The IHE Technical Framework in future years may define patient reconciliation transactions using MPI.

The IHE Technical Framework: Year 2 also supports cases when registration or temporary registration of a patient by ADT is not applicable or desired, for example:

- Emergency Department patient who can be identifid themselves but due to constraints requires the procedure to be performed before proper order entry and scheduling may occur.
- Patient ID, though valid, has never been propagated to all actors due to communication failures, or the wrong Patient record was used in ordering/scheduling.
- Patient ID, though valid, has been mistyped at the modality.

The following additional use cases are identified (see sections 5.4.2.4 and 5.4.2.5):

- Case 4: Unidentified Patient assigned temporary Departmental ID and scheduled at DSS/Order Filler
- Case 5: Image Acquisition completed prior to assigning temporary Departmental ID or Order

Cases 4 and 5 require patient reconciliation on the department level. In the case of procedures performed on the unidentified patient in multiple departments (e.g., Radiology and Laboratory), this will require reconciliation of patient information in multiple locations. To address this issue, the IHE Technical Framework in future years may define patient reconciliation transactions using Master Patient Index (MPI).

Note:

The IHE Technical Framework: Year 2 also recognizes that the following case of handling unidentified patients may be utilized in certain installations:

- The patient is delivered to the department where it is assigned a temporary departmental Patient ID and/or name.
- The order is then entered by the DSS/Order Filler and with this Patient ID and/or name, the procedure is performed on the Acquisition Modality.

- The DSS/Order Filler sends a new order transaction to the Order Placer. Thus this departmental Patient ID will be shared by Image Manager, DSS/Order Filler and Order Placer. However, this departmental Patient ID will not be known to the ADT.
- After resolution of the patient identity, the ADT registers/admits patient with the correct Patient ID and sends a message to the Order Placer and DSS/Order Filler. Each system must locally merge the new record with the existing one identified by the departmental Patient ID.

Because of the need to perform reconciliation in multiple points throughout the enterprise, it is not recommended to use the workflow described in this note in the environment integrated in accordance with the IHE Technical Framework: Year 2. IHE Technical Framework in future years may define patient reconciliation transactions for this or similar cases using single point reconciliation with Master Patient Index (MPI).

5.4.2　Use Cases

The following sections describe the Unidentified Patient use cases. For the purpose of simplification, the following transaction were omitted from the corresponding diagrams:

- Modality Performed Step In Progress
- Modality Images Stored
- Modality Presentation State Stored
- Modality Storage Commitment

These transactions may occur within the time frame of the diagram, but their content does not affect each of the use cases

5.4.2.1　Case 1: Unidentified Patient registered at ADT and ordered at Order Placer

The ADT is a single point of patient reconciliation in the enterprise. Process flow requires that any unidentified patient be assigned a permanent Patient ID and a temporary name (e.g., "John Doe"). In this case, either the patient is registered/admitted electronically at the time of arrival, or is assigned a temporary Patient ID and name. All subsequent transactions follow the normal flow (see section 5.1) including order entry and procedure scheduling. When the real patient identity is known, the ADT is responsible for reconciliation of its own records as well as informing the Order Placer and DSS/Order Filler about corresponding changes. The ADT sends a Patient Update message to both the Order Placer and DSS/Order Filler. The DSS/Order Filler sends the Patient Update message to the Image Manager.
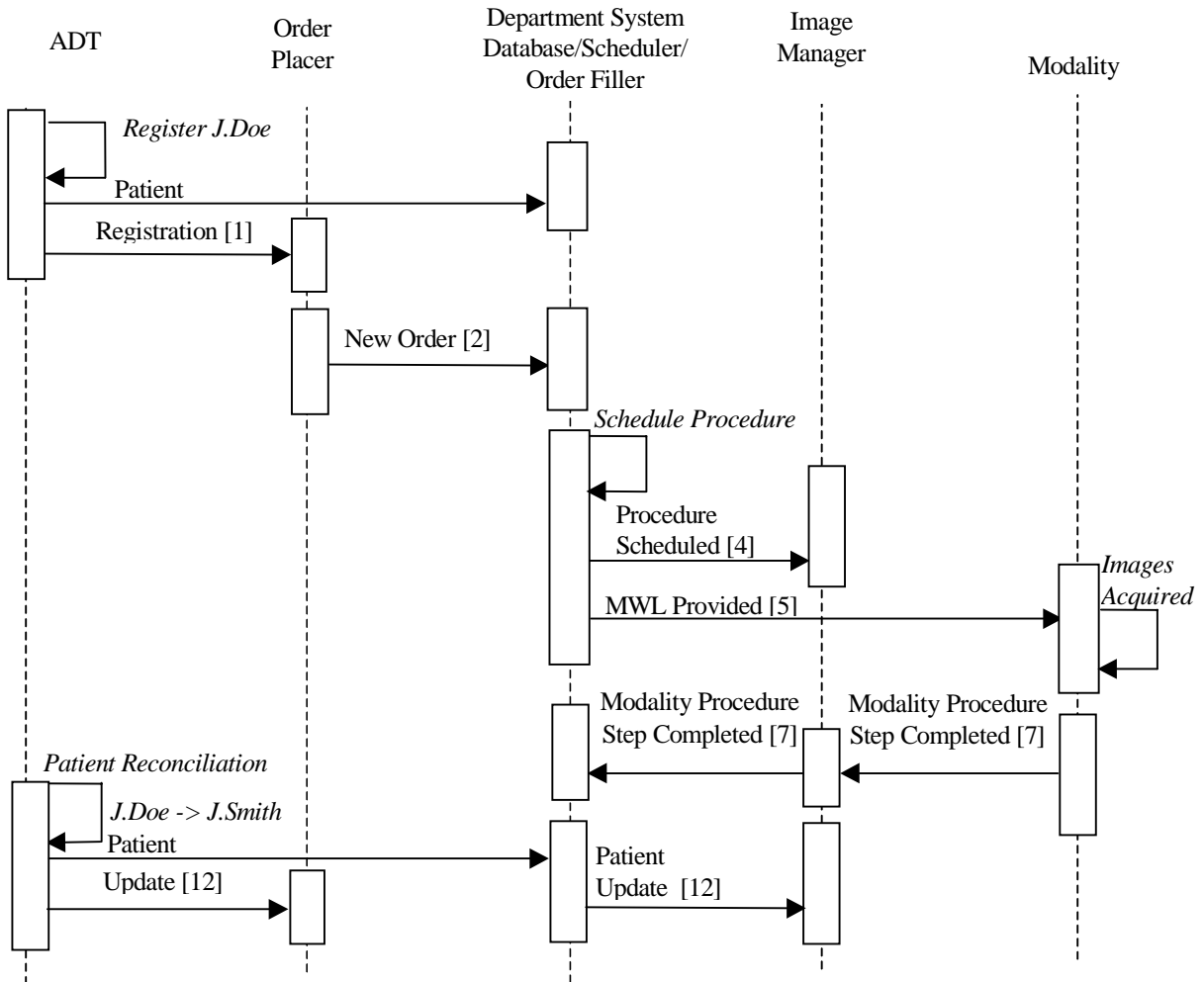
Figure 5.4-1. Unidentified Patient– Case 1

Significant Transactions:

- To reconcile the patient information, the ADT may register a new patient and merge the temporary patient with the correct patient and send both registration and merge transactions.

- If a permanent Patient ID was assigned, then the ADT may only send a Patient Update transaction with proper information.

5.4.2.2   Case 2: Unidentified Patient registered at ADT and ordered at DSS/Order Filler

This case is based on case 1. However, in this situation the order for a procedure is generated by the DSS/Order Filler and submitted to the Order Placer. Procedures are scheduled normally and image acquisition uses modality worklist. When the patient information is reconciled, the ADT

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sends the Patient Update messages to both the Order Placer and DSS/Order Filler. The DSS/Order Filler sends the Patient Update message to the Image Manager.

Figure 5.4-2. Unidentified Patient– Case 2

Significant Transactions:

- To reconcile the patient information, the ADT may register a new patient and merge the temporary patient with the correct patient and send both registration and merge transactions.

- If a permanent Patient ID was assigned, then the ADT may only send a Patient Update transaction with proper information.

- A New Order transaction is sent from DSS/Order Filler to the Order Placer.

5.4.2.3 Case 3: Unidentified Patient registered at ADT but completed at Modality prior to Order

As in cases 1 and 2, this uses a permanent Patient ID generated by the ADT. However, no order entry or scheduling takes place before the procedure is performed by the Acquisition Modality. A permanent Patient ID and a temporary name are manually entered at the Acquisition Modality (typically, from a card) and conveyed to the DSS/Order Filler and the Image Manager by the Acquisition Modality. Subsequently, the DSS/Order Filler generates and submits an order to the Order Placer. When the patient information is reconciled, the ADT sends the Patient Update messages to both the Order Placer and the DSS/Order Filler. The DSS/Order Filler sends a Patient Update message to the Image Manager.

Figure 5.4-3. Unidentified Patient– Case 3

Significant Transactions:

- On receiving a PPS message, the DSS/Order Filler recognizes it as an unscheduled case.

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- The DSS/Order Filler sends a New Order transaction to the Order Placer.

- Using the information from the Performed Procedure Step message and placed order, the DSS/Order Filler creates new Requested Procedure record and sends a Procedure Scheduled transaction to the Image Manager.

- To reconcile the patient information, the ADT may register a new patient and merge the temporary patient with the correct patient and send both registration and merge transactions.

- If a permanent Patient ID was assigned, then the ADT may only send a Patient Update transaction with proper information.

- The DSS/Order Filler sends a Patient Update message to the Image Manager.

5.4.2.4 Case 4: Unidentified Patient assigned Temporary Departmental ID and Scheduled at DSS/Order Filler

In this case, no valid Patient ID is available to the DSS/Order Filler. It assigns a temporary Patient ID and a temporary name and schedules the required procedure.

> **Note:** The DSS/Order Filler must ensure that the assigned temporary Patient ID is unique within its scope.

The temporary Patient ID is conveyed to the Image Manager. When patient information becomes known, the ADT sends new patient information to both the Order Placer and the DSS/Order Filler. The DSS/Order Filler reconciles received patient information with that associated with the temporary Patient ID and merges the permanent patient record with its own temporary one and sends a Patient Update message to the Image Manager. At the same time, the DSS/Order Filler generates and submits an order to the Order Placer using a permanent Patient ID.
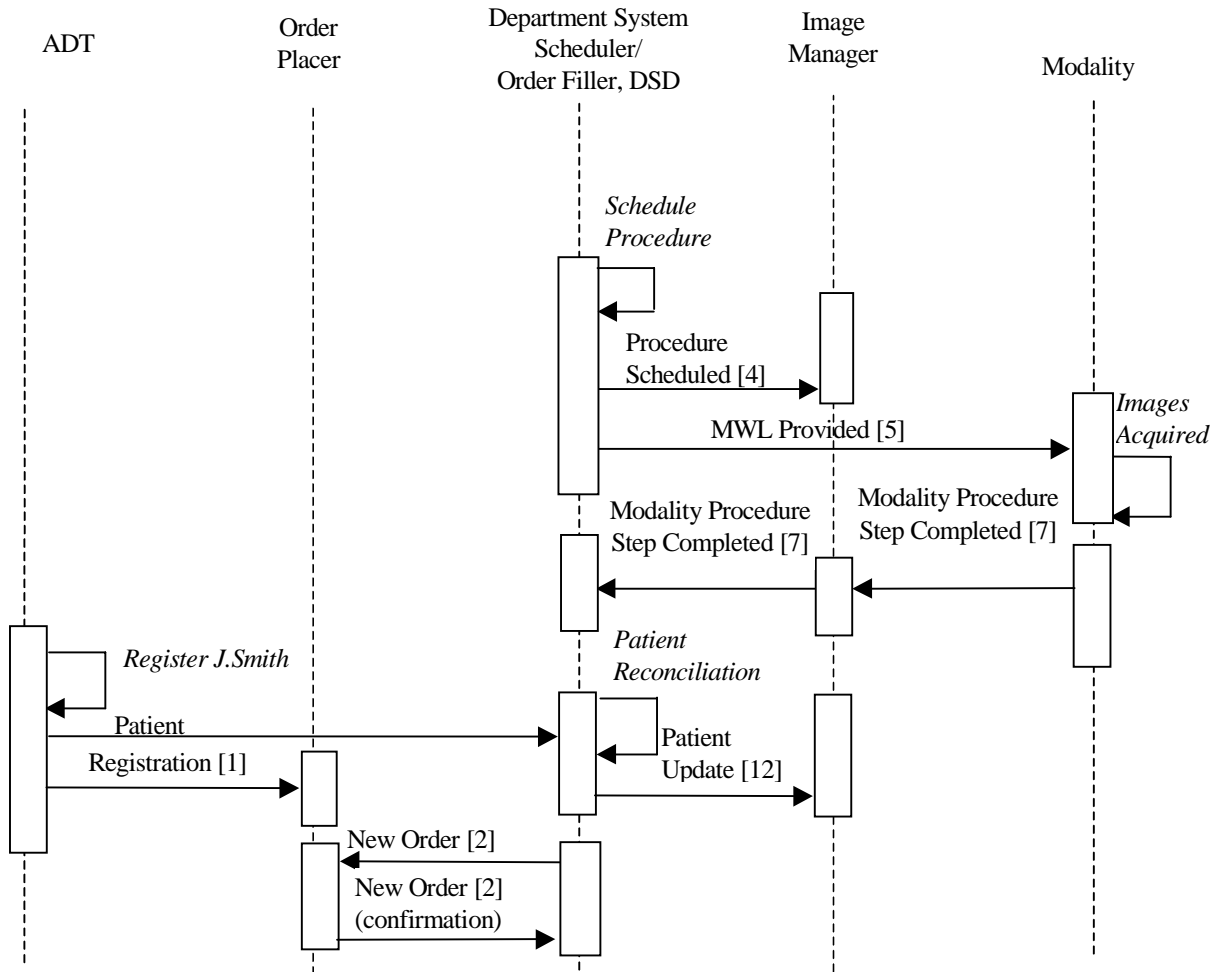
Figure 5.4-4. Unidentified Patient– Case 4

Significant Transactions:

- Patient information is reconciled internally by the DSS/Order Filler using the Patient Registration from ADT.

- The DSS/Order Filler sends the Patient Ppdate to the Image Manager.

- The DSS/Order Filler sends the New Order transaction to the Order Placer.

5.4.2.5   Case 5: Image Acquisition completed prior to assigning Temporary Departmental ID or Order

In this case, no valid Patient ID is available to the DSS/Order Filler and no scheduling is done before the procedure is performed. A temporary ID and name are entered by the technologist at the Modality and conveyed to the DSS/Order Filler and to the Image Manager. The Patient ID and name are selected by the technologist according to the locally defined rules; for example,

selected from the predefined pool of "Patient ID – patient name" pairs. The rules for selecting temporary Patient ID shall guarantee its uniqueness within the scope of DSS/Order Filler.

Upon receiving the Modality Procedure Step Completed message, the DSS/Order Filler and Image Manager recognize an unscheduled case based on the content of the message (see Note IHE-3 in appendix C). When patient information becomes known, the ADT sends the new patient information to both the Order Placer and DSS/Order Filler. The DSS/Order Filler performs a merge of the permanent patient record with the temporary one and sends a Patient Update to the Image Manager. At the same time, DSS/Order Filler generates and submits an order to the Order Placer using a valid Patient ID.
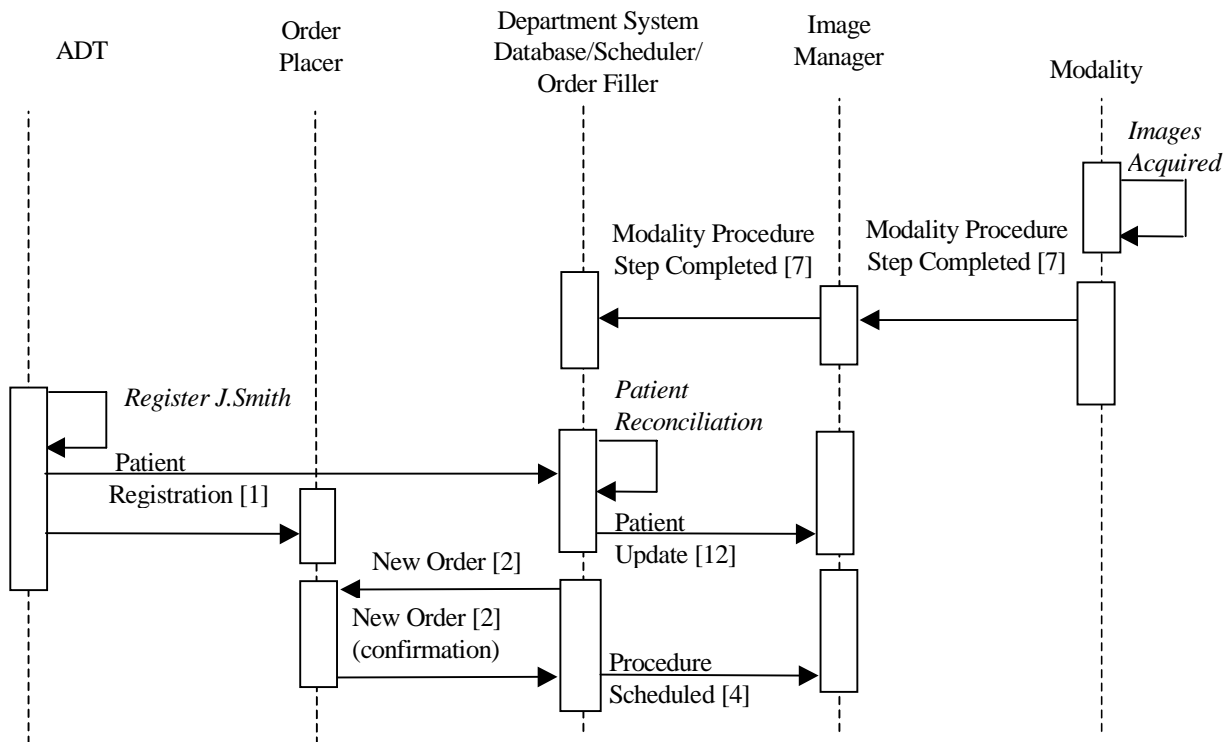
Figure 5.4-5. Unidentified Patient – Case 5

Significant Transactions:

- On receiving a PPS message, the DSS/Order Filler recognizes it as an unscheduled case.

- Patient information is reconciled internally by the DSS/Order Filler using the Patient Registration from the ADT.

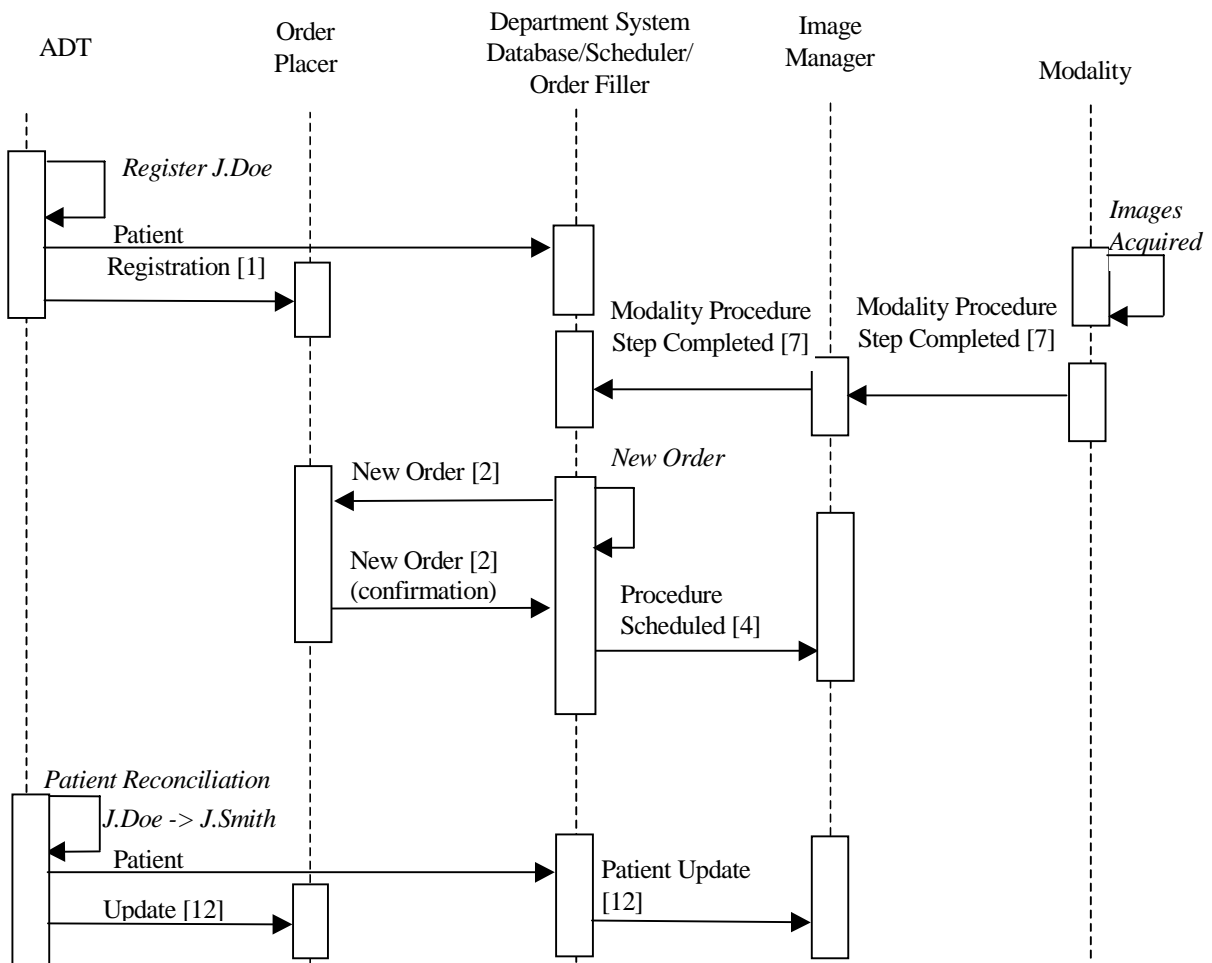- The DSS/Order Filler sends a Patient Update message to the Image Manager.

- The DSS/Order Filler sends a New Order transaction to the Order Placer.

- Using the information from the Performed Procedure Step message and placed order, the DSS/Order Filler creates new Requested Procedure record and sends a Procedure Scheduled Transaction to the Image Manager.

5.5   Virtual Image Set Split

Virtual Image Set Split provides a mechanism for facilitating viewing images and reporting on individual Requested Procedures that have been fullfilled by a single Performed Procedure Step acquisition. The transactions covered are 5 through 10.

The following use case illustrates the Virtual Image Set Split flow:

- Two Requested Procedures (CT of the chest, and CT of the abdomen) are scheduled to fulfill an Order. A single Helical CT acquisition of the upper body is performed and a Modality Performed Procedure Step Completed transaction informing that both Requested Procedures have been grouped into one acquisition is sent to the Image Manager and Department System Scheduler/Order Filler (group case, see section 6.6.4.1.2.3.4). Since two Requested Procedures have been satisfied, two reports may need to be created. The images are stored in the Image Archive and Storage Commitment is performed.

- The technologist may create two Grayscale Softcopy Presentation States (GSPSs). One GSPS references the subset of images that correspond to the chest, and includes the viewing parameters (e.g. window/level settings) appropriate for the CT chest images. The other GSPS references the abdomen images subset, and includes different viewing parameters appropriate for the CT abdomen images. A Performed Procedure Step transaction indicating that the chest and abdomen GSPSs have been created is sent to the Image Manager and Department System Scheduler/Order Filler (append case, see section 6.6.4.1.2.3.3). The GSPSs are stored in the Image Archive and Storage Commitment is performed.

- A radiologist may use the GSPSs created by the technologist to facilitate viewing and interpreting the CT chest images separately from the CT abdomen images.

An implementation may choose to:

- Include the results of Perform Acquisition and of Create GSPS in a single MPPS object;
- Use two MPPS objects as described above and shown in figure 5.5-1; or
- Use several MPPS objects, one for the results of Perform Acquisition, plus a separate MPPS object for each GSPS created (e.g. the results of CT Chest Create GSPS and CT Abdomen Create GSPS).

The following sequence of steps describes the typical process flow involved in the Virtual Image Set Split:
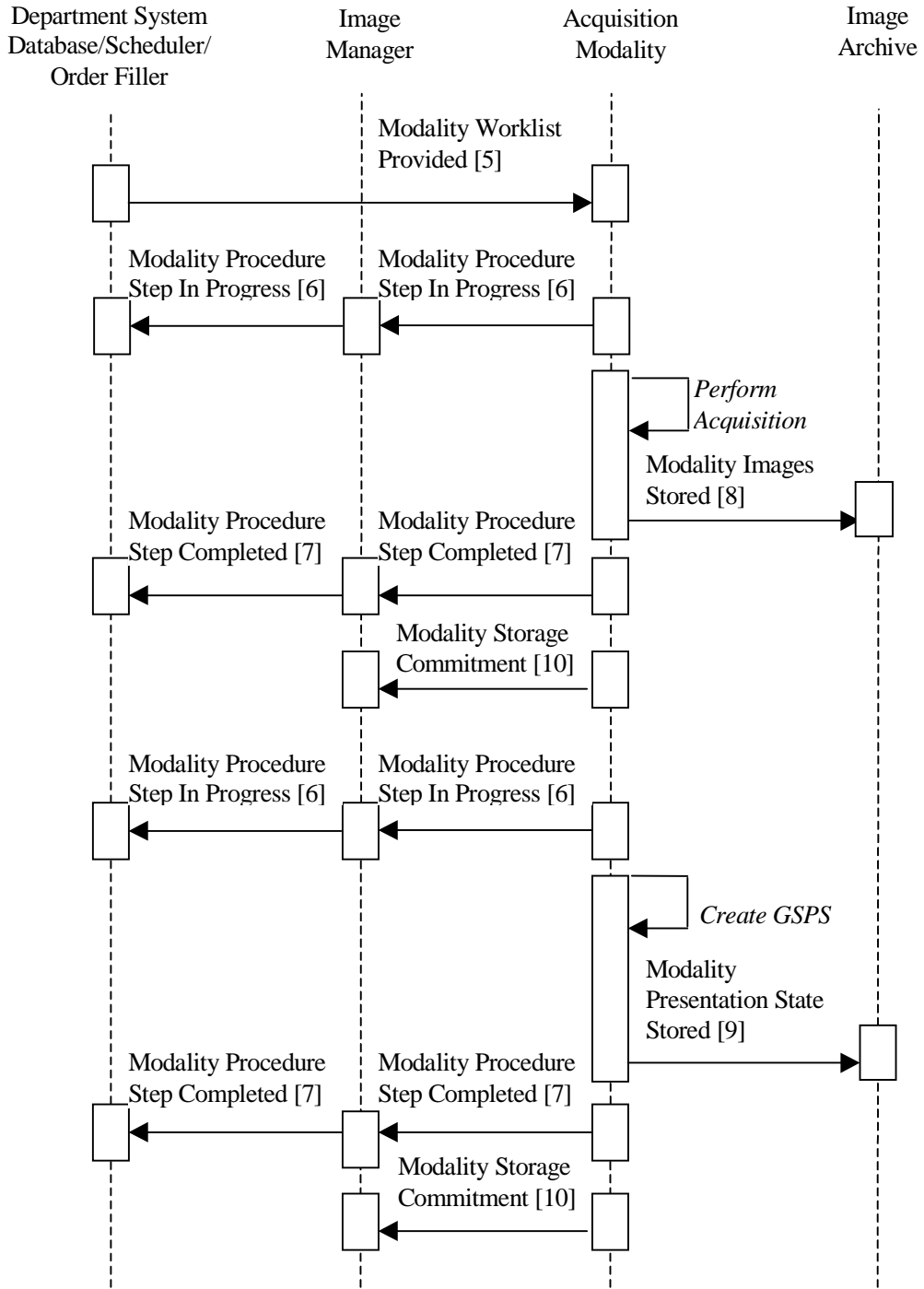
Figure 5.5-1. Virtual Image Set Split Process Flow

6 IHE Transactions

This section defines each IHE transaction in detail, specifying the standards used, the information transferred, and the conditions under which the transaction is required or optional.

6.1 Patient Registration

This section corresponds to Transaction 1 of the IHE Technical Framework: Year 2. Transaction 1 is required for the ADT, Order Placer and Department System Scheduler/Order Filler actors.

6.1.1 Scope

This process step involves the patient information, including demographics, captured at the point of encounter. This may occur when the visit is scheduled, if that precedes patient arrival at the institution. This transaction is used for both in-patients (i.e., those who are assigned a bed at the facility) and out-patients (i.e., those who are not assigned a bed at the facility) only when the new record is being created for a patient.

6.1.2 Use Case Roles
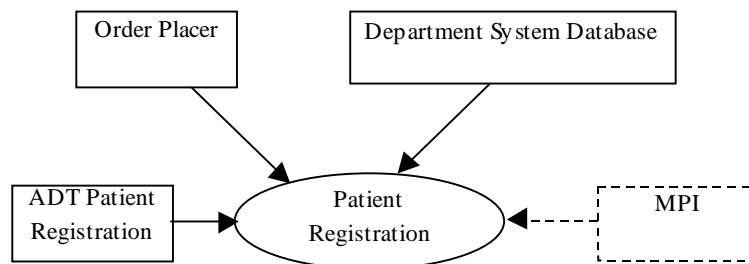
Actor: ADT

Role: Adds and modifies patient demographic and encounter information.

Actor: Order Placer

Role: Receives patient and encounter information for use in order entry.

Actor: Department System Database

Role: Receives and stores patient and encounter information for use in fulfilling orders by the Department System Scheduler.

Actor: MPI

Role: Receives patient and encounter information from multiple ADT systems. Maintains unique enterprise-wide identifier for a patient.

6.1.3 Referenced Standards

HL7 2.3.1 Chapters 2, 3

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6.1.4   Interaction Diagram
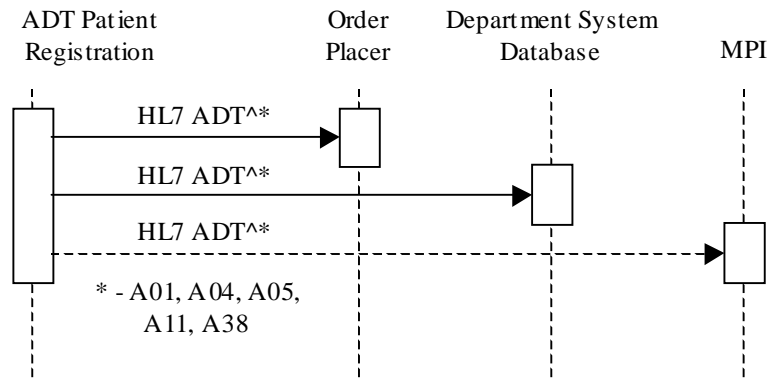
Note: IHE Technical Framework:Year 2 does not support the use of a Master Patient Index which is required for synchronization of patient information between multiple ADT systems employed by a healthcare enterprise. It is expected the IHE initiative will include an MPI Actor in the future and that the Patient Registration Transaction between the ADT and MPI will be similar to the transaction between the ADT and Order Placer and Order Filler actors.

6.1.4.1   Patient Management – Admit/Register Patient

6.1.4.1.1   Trigger Events

The following events will trigger one of the Admit/Register messages:

- A01 – Admission of an in-patient into a facility
- A04 – Registration of an out-patient for a visit of the facility
- A05 – Pre-admission of an in-patient (i.e., registration of patient information ahead of actual admission).

6.1.4.1.2   Message Semantics

The Patient Registration transaction is conducted by the HL7 ADT message. The message shall be generated by the ADT Actor whenever a patient is admitted, pre-admitted or registered. The segments of the message listed below are required, and their detailed descriptions are provided in tables 6.1-1 through 6.1-4 and corresponding notes. All other segments are optional.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2.3.

ADT	Patient Administration Message	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

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AL1	Allergy Information	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. The segments of ACK message listed below are required, and their detailed descriptions are provided in tables 6.1-1, 6.1-6 and corresponding notes. All other segments are optional.

ACK	Acknowledgement Message	Chapter in HL7 2.3.1
MSH	Message Header	2
MSA	Message Acknowledgement	2

The following tables provide field-by-field definitions of the required segments of the ADT/ACK messages of the Patient Registration transaction. These tables shall be interpreted according to the HL7 Standard unless otherwise noted in section 2.3 and notes beneath the tables.

Table 6.1-1. IHE Profile - MSH segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R		00001	Field Separator
2	4	ST	R		00002	Encoding Characters
3	180	HD	R		00003	Sending Application
4	180	HD	R		00004	Sending Facility
5	180	HD	R		00005	Receiving Application
6	180	HD	R		00006	Receiving Facility
7	26	TS	O		00007	Date/Time Of Message
8	40	ST	O		00008	Security
9	7	CM	R		00009	Message Type
10	20	ST	R		00010	Message Control ID
11	3	PT	R		00011	Processing ID
12	8	ID	R	0104	00012	Version ID
13	15	NM	O		00013	Sequence Number
14	180	ST	O		00014	Continuation Pointer
15	2	ID	O	0155	00015	Accept Acknowledgment Type
16	2	ID	O	0155	00016	Application Acknowledgment Type
17	2	ID	O		00017	Country Code
18	6	ID	C	0211	00692	Character Set
19	60	CE	O		00693	Principal Language Of Message

Adapted from the HL7 Standard, version 2.3.1

The IHE Technical Framework requires that applications support HL7-recommended values for the fields *MSH-1 Field Separator* and *MSH-2 Encoding Characters*.

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Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ADT" for ADT message and "ACK" for the ACK message; the second component shall have values of A01, A04 or A05 as appropriate. The third component is optional; however, if present, it shall have a value of ADT_01.

Implementations supporting sequence number protocol shall be configurable to allow them to perform this transaction without such protocol.

Table 6.1-2. IHE Profile - EVN segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	3	ID	O	0003	00099	Event Type Code
2	26	TS	R		00100	Recorded Date/Time
3	26	TS	O		00101	Date/Time Planned Event
4	3	IS	O	0062	00102	Event Reason Code
5	60	XCN	O	0188	00103	Operator ID
6	26	TS	R2		01278	Event Occurred

Adapted from the HL7 Standard, version 2.3.1

Table 6.1-3. IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00104	Set ID - Patient ID
2	20	CX	O		00105	Patient ID
3	20	CX	R		00106	Patient Identifier List
4	20	CX	O		00107	Alternate Patient ID
5	48	XPN	R		00108	Patient Name
6	48	XPN	O		00109	Mother's Maiden Name
7	26	TS	R		00110	Date/Time of Birth
8	1	IS	R	0001	00111	Sex
9	48	XPN	O		00112	Patient Alias
10	1	IS	R2	0005	00113	Race
11	106	XAD	R2		00114	Patient Address
12	4	IS	O		00115	County Code
13	40	XTN	O		00116	Phone Number - Home
14	40	XTN	O		00117	Phone Number - Business
15	60	CE	O	0296	00118	Primary Language
16	1	IS	O	0002	00119	Marital Status
17	3	IS	O	0006	00120	Religion
18	20	CX	R		00121	Patient Account Number
19	16	ST	O		00122	SSN Number – Patient
20	25	DLN	O		00123	Driver's License Number - Patient
21	20	CX	O		00124	Mother's Identifier

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22	3	IS	O	0189	00125	Ethnic Group
23	60	ST	O		00126	Birth Place
24	2	ID	O	0136	00127	Multiple Birth Indicator
25	2	NM	O		00128	Birth Order
26	4	IS	O	0171	00129	Citizenship
27	60	CE	O	0172	00130	Veterans Military Status
28	80	CE	O		00739	Nationality
29	26	TS	O		00740	Patient Death Date and Time
30	1	ID	O	0136	00741	Patient Death Indicator

Adapted from the HL7 standard, version 2.3.1

Note: Every system participating in the information exchange using HL7 shall use the field PID-3 Patient Identifier List to convey the Patient ID uniquely identifying the patient, typically at the Master Patient Index. If the Master Patient Index is not available, the ID initially assigned by the ADT/Registration System may be conveyed in this field(IHE Technical Framework: Year 2 does not provide for the use of an MPI). See appendix D and appendix G for further discussion of the use of PID-3 in transactions and its mapping from HL7 messages to DICOM Patient ID (0010,0020).

Table 6.1-4. IHE profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00131	Set ID - PV1
2	1	IS	R	0004	00132	Patient Class
3	80	PL	R		00133	Assigned Patient Location
4	2	IS	O	0007	00134	Admission Type
5	20	CX	O		00135	Preadmit Number
6	80	PL	O		00136	Prior Patient Location
7	60	XCN	R2	0010	00137	Attending Doctor
8	60	XCN	R2	0010	00138	Referring Doctor
9	60	XCN	R2	0010	00139	Consulting Doctor
10	3	IS	O	0069	00140	Hospital Service
11	80	PL	O		00141	Temporary Location
12	2	IS	O	0087	00142	Preadmit Test Indicator
13	2	IS	O	0092	00143	Readmission Indicator
14	3	IS	O	0023	00144	Admit Source
15	2	IS	C	0009	00145	Ambulatory Status
16	2	IS	O	0099	00146	VIP Indicator
17	60	XCN	R2	0010	00147	Admitting Doctor
18	2	IS	O	0018	00148	Patient Type
19	20	CX	R2		00149	Visit Number
20	50	FC	O	0064	00150	Financial Class
21	2	IS	O	0032	00151	Charge Price Indicator

22	2	IS	O	0045	00152	Courtesy Code
23	2	IS	O	0046	00153	Credit Rating
24	2	IS	O	0044	00154	Contract Code
25	8	DT	O		00155	Contract Effective Date
26	12	NM	O		00156	Contract Amount
27	3	NM	O		00157	Contract Period
28	2	IS	O	0073	00158	Interest Code
29	1	IS	O	0110	00159	Transfer to Bad Debt Code
30	8	DT	O		00160	Transfer to Bad Debt Date
31	10	IS	O	0021	00161	Bad Debt Agency Code
32	12	NM	O		00162	Bad Debt Transfer Amount
33	12	NM	O		00163	Bad Debt Recovery Amount
34	1	IS	O	0111	00164	Delete Account Indicator
35	8	DT	O		00165	Delete Account Date
36	3	IS	O	0112	00166	Discharge Disposition
37	25	CM	O	0113	00167	Discharged to Location
38	2	IS	O	0114	00168	Diet Type
39	2	IS	O	0115	00169	Servicing Facility
40	1	IS	O	0116	00170	Bed Status
41	2	IS	O	0117	00171	Account Status
42	80	PL	O		00172	Pending Location
43	80	PL	O		00173	Prior Temporary Location
44	26	TS	O		00174	Admit Date/Time
45	26	TS	O		00175	Discharge Date/Time
46	12	NM	O		00176	Current Patient Balance
47	12	NM	O		00177	Total Charges
48	12	NM	O		00178	Total Adjustments
49	12	NM	O		00179	Total Payments
50	20	CX	O	0192	00180	Alternate Visit ID
51	1	IS	O	0326	01226	Visit Indicator
52	60	XCN	O	0010	01224	Other Healthcare Provider

Adapted from the HL7 standard, version 2.3.1

Note: PID-18 (Patient Account Number) is required. PV1-19 (Visit Number) is required when PID-18 identifies an account which spans more than one Encounter or Visit.

Table 6.1-5. IHE Profile – AL1 segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00203	Set ID - AL1
2	2	IS	O	0127	00204	Allergy Type
3	60	CE	R		00205	Allergy

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						Code/Mnemonic/Description
4	2	IS	O	0128	00206	Allergy Severity
5	15	ST	O		00207	Allergy Reaction
6	8	DT	O		00208	Identification Date

Adapted from the HL7 standard, version 2.3.1

Table 6.1-6. IHE Profile - MSA segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0008	00018	Acknowledgment Code
2	20	ST	R		00010	Message Control ID
3	80	ST	O		00020	Text Message
4	15	NM	O		00021	Expected Sequence Number
5	1	ID	O	0102	00022	Delayed Acknowledgment Type
6	100	CE	O		00023	Error Condition

Adapted from the HL7 standard, version 2.3.1

6.1.4.1.3   Expected Actions

The receiver of the ADT Patient Registration transaction message shall create a new patient record for the patient identified if there is no current record for the Patient ID (defined by *PID-2* or, if it is empty, by *PID-3*). Interpretation of A01, A04 and A05 messages after the patient record was created is beyond the scope of the IHE Technical Framework; however, the ADT Patient Registration transaction shall not be used to update information in an existing patient record. Transaction 12 Patient Update shall be used instead.

6.1.4.2   Patient Management – Cancel Admit/Register Patient

6.1.4.2.1   Trigger Events

The following events will trigger one of the Admit/Register messages:

- A11 – Admission of an in-patient into a facility or registration of an out-patient for a visit of the facility has been cancelled due to error in the information or the decision not to admit/register patient after all.
- A38 – Pre-admission of an in-patient (i.e., registration of patient information ahead of actual admission) has been cancelled due to error in the information or the decision not to admit/register patient after all.

6.1.4.2.2   Message Semantics

Patient Registration conveyed by the HL7 ADT^A01, ADT^A04 or ADT^A05 may have to be revoked due to the errors in the information or the decision of not admitting/registering patient. The cancellation transaction is conveyed by the HL7 ADT^A11 or ADT^A38 messages.

ADT^A11 shall be used to revoke the transaction conveyed by the ADT^A01 or ADT^A04 message. ADT^A38 shall be used to revoke transaction conveyed by the ADT^A05 message.

Cancellation messages shall only be used if no other transactions were performed by the ADT on the patient record after the admit/registration transaction was conveyed.

6.1.4.2.3   Expected Actions

If the patient record was created as a result of Patient Registration transaction, it shall be discarded. If the Patient Registration transaction was sent for an existing patient record, the corresponding operations shall be "rewound" to restore the record condition existing before Patient Transaction was sent.

6.2   New Order

This section corresponds to Transaction 2 of the IHE Technical Framework: Year 2. Transaction 2 is required for the Order Placer and Department System Scheduler/Order Filler actors.

6.2.1   Scope

This transaction is used by the Order Placer to place a new order with the Order Filler. It also allows the Order Filler to inform the Order placer about the new order the Order Filler had to create and fulfill. The Order Placer and Department System Scheduler/Order Filler must agree on the support of recurring orders and panel orders, if used.

Recurring order: An order with a performance frequency greater than one. For example, portable chest x-ray at 6:00 AM for the next seven days.

Panel order: A service item with more than one observation component. For example, a nuclear cardiac study, which has a cardiology component and a radiology component, which are usually reported on separately.

6.2.2   Use Case Roles
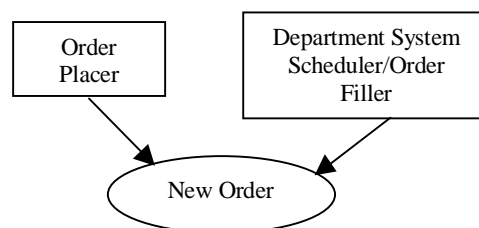
Actor: Order Placer

Role: Places orders. Receives orders from order filler (department) system.

Actor: Department System Scheduler/Order Filler

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Role: Receives and processes (fills) orders. Creates new orders. Informs Order Placer of order status changes

6.2.3   Referenced Standards

HL7 2.3.1 Chapter 4, 7

6.2.4   Interaction Diagram

Order Created:
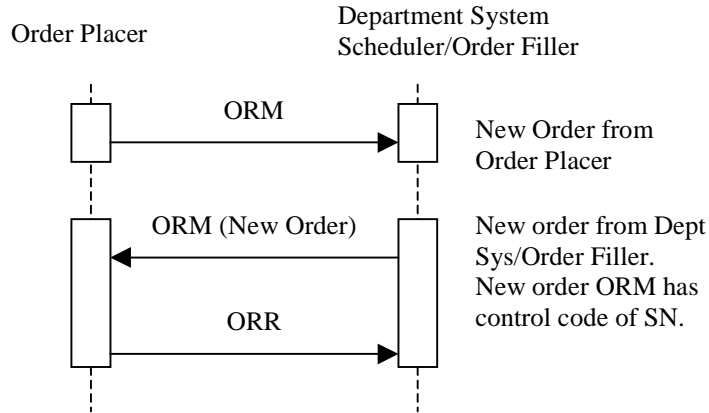
Note: ORR messages are sent by the Order Placer to convey the Order Placer Number in those cases where the DSS/Order Filler places the Order. ORR messages are not used as acknowledgements in other cases.

Order Status updated:
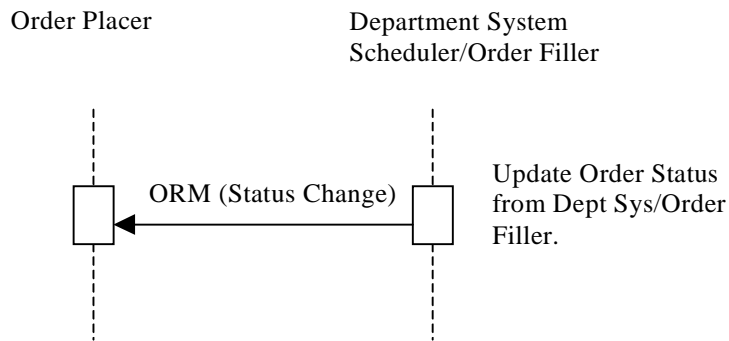
6.2.4.1   Order Management – New Order from Order Placer

6.2.4.1.1   Trigger Events

ORM – The Order Placer places a new order for the Department System Scheduler/Order Filler.

6.2.4.1.2   Message Semantics

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics. See section 6.1 of this document for MSH, PID and PV1 segments.

The order start date/time or exam date/time are required in the "Quantity/Timing" field of both the ORC and OBR segments (ORC-7.4; OBR-27.4).

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2.3.

Required segments are listed below. Other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
{ORC	Common Order	4
OBR	Order Detail	4
{ [OBX] } }	Observation Results	7

The OBX segment (observation results) is included to allow the transmission of the certain observation which may be required for proper handling of order, in particular, patient weight and height. A system that has patient weight and height information shall include corresponding OBX segments, among others. If this information is not known, sending system may still include OBX segments for other parameters.

Table 6.2-1. IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	C		00216	Placer Order Number
3	22	EI	R2		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
5	2	ID	C	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	R		00221	Quantity/Timing
8	200	CM	C		00222	Parent
9	26	TS	R		00223	Date/Time of Transaction
10	120	XCN	R2		00224	Entered By
11	120	XCN	O		00225	Verified By
12	120	XCN	R		00226	Ordering Provider
13	80	PL	O		00227	Enterer's Location

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14	40	XTN	R2		00228	Call Back Phone Number
15	26	TS	O		00229	Order Effective Date/Time
16	200	CE	O		00230	Order Control Code Reason
17	60	CE	R		00231	Entering Organization
18	60	CE	O		00232	Entering Device
19	120	XCN	O		00233	Action By

Adapted from the HL7 Standard, version 2.3.1

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. HL7 defines a number of Order Control codes.

The order control codes below shall be supported.

Table 6.2-2. IHE Profile - Supported Order Control Codes

Value	Description	Originator
NW [R]	New order	P
PA [O]	Parent order	F,P
CH [O]	Child order	F,P
SN [R]	Send order number	F
NA [R]	Number assigned	P
SC [R]	Status Changed	F

Adapted from the HL7 Standard, version 2.3.1

P=Placer; F=Filler; [R]=Required; [O]=Optional

Note: The use of Required/Optional superscripts in the Value column is an IHE extension and is not part of the HL7 Standard.

Table 6.2-3. IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	C		00237	Set ID - OBR
2	75	EI	C		00216	Placer Order Number
3	75	EI	C		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
5	2	ID	O		00239	Priority
6	26	TS	O		00240	Requested Date/time
7	26	TS	O		00241	Observation Date/Time
8	26	TS	O		00242	Observation End Date/Time
9	20	CQ	O		00243	Collection Volume
10	60	XCN	O		00244	Collector Identifier
11	1	ID	O	0065	00245	Specimen Action Code
12	60	CE	R2		00246	Danger Code
13	300	ST	R2		00247	Relevant Clinical Info.

14	26	TS	O		00248	Specimen Received Date/Time
15	300	CM	C	0070	00249	Specimen Source
16	80	XCN	R		00226	Ordering Provider
17	40	XTN	O		00250	Order Callback Phone Number
18	60	ST	O		00251	Placer field 1
19	60	ST	O		00252	Placer field 2
20	60	ST	O		00253	Filler Field 1
21	60	ST	O		00254	Filler Field 2
22	26	TS	O		00255	Results Rpt/Status Chng - Date/Time
23	40	CM	O		00256	Charge to Practice
24	10	ID	O	0074	00257	Diagnostic Serv Sect ID
25	1	ID	O	0123	00258	Result Status
26	400	CM	O		00259	Parent Result
27	200	TQ	R		00221	Quantity/Timing
28	150	XCN	O		00260	Result Copies To
29	150	CM	C		00261	Parent
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
32	200	CM	O		00264	Principal Result Interpreter
33	200	CM	O		00265	Assistant Result Interpreter
34	200	CM	O		00266	Technician
35	200	CM	O		00267	Transcriptionist
36	26	TS	O		00268	Scheduled Date/Time
37	4	NM	O		01028	Number of Sample Containers
38	60	CE	O		01029	Transport Logistics of Collected Sample
39	200	CE	O		01030	Collector's Comment
40	60	CE	O		01031	Transport Arrangement Responsibility
41	30	ID	R2	0224	01032	Transport Arranged
42	1	ID	O	0225	01033	Escort Required
43	200	CE	O		01034	Planned Patient Transport Comment

Adapted from the HL7 Standard, version 2.3.1

Note: Specimen source holds the laterality (Left/Right) indicator (when used) in the <site modifier (CE)> component. See appendix D for details.

Table 6.2-4. IHE Profile - OBX Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	10	SI	O		00569	Set ID - OBX
2	2	ID	C	0125	00570	Value Type
3	590	CE	R2		00571	Observation Identifier

4	20	ST	C		00572	Observation Sub-ID
5	65536[1]	*	C		00573	Observation Value
6	60	CE	O		00574	Units
7	10	ST	O		00575	References Range
8	5	ID	O	0078	00576	Abnormal Flags
9	5	NM	O		00577	Probability
10	2	ID	O	0080	00578	Nature of Abnormal Test
11	1	ID	O	0085	00579	Observ Result Status
12	26	TS	O		00580	Date Last Obs Normal Values
13	20	ST	O		00581	User Defined Access Checks
14	26	TS	O		00582	Date/Time of the Observation
15	60	CE	O		00583	Producer's ID
16	80	XCN	O		00584	Responsible Observer
17	60	CE	O		00936	Observation Method

Adapted from the HL7 Standard, version 2.3.1

Note: The IHE Technical Framework includes the OBX segment primarily for the purposes of communicating patient height and weight. In this context, ITEM# 571 (Observation Identifier) has been changed to "R2" (OPT) and ITEM# 579 (Observation Result Status) has been changed to "O". Please refer to appendix D for additional details on Patient Height and Weight mapping.

The OPT value for 00574 Units is O. The IHE Technical Framework is using these OBX segments to send Patient Height and Weight. When the OBX segments are sent to transmit the height and weight, OBX.6 (Units) should be populated.

6.2.4.1.3   Expected Actions

Department System Scheduler/Order Filler shall accept the order information for fulfillment. If error in data prevents it from fulfilling the order, it should notify the Order Placer by returning proper information in the ACK message.

6.2.4.2   Order Management – New Order from Order Filler

6.2.4.2.1   Trigger Events

ORM - Department system Scheduler/Order Filler places an order (control code = SN).

ORR – Order Placer replies (control code = NA).

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[1] The length of the observation value field is variable, depending upon value type. See *OBX-2-value type*.

6.2.4.2.2   Message Semantics

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics. Refer to section 6.2.4.1.2 above for detailed requirements for the ORM message.

HL7 2.3.1 Chapter 4 ORR message. Refer to HL7 Standard for general message semantics.

See section 6.1 of this document for MSH and MSA segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2.3.

Required segments are listed below. Other segments are optional.

ORR	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
ORC	Common Order	4
OBR	Order Detail	4

Table 6.2-5. IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
5	2	ID	R	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	C		00221	Quantity/Timing
8	200	CM	C		00222	Parent
9	26	TS	R		00223	Date/Time of Transaction
10	120	XCN	R2		00224	Entered By
11	120	XCN	O		00225	Verified By
12	120	XCN	R		00226	Ordering Provider
13	80	PL	O		00227	Enterer's Location
14	40	XTN	R2		00228	Call Back Phone Number
15	26	TS	R		00229	Order Effective Date/Time
16	200	CE	O		00230	Order Control Code Reason
17	60	CE	R		00231	Entering Organization
18	60	CE	O		00232	Entering Device
19	120	XCN	O		00233	Action By

Adapted from the HL7 Standard, version 2.3.1

The Order Control code passed as part of the message must have value NA – Number Assigned by the Order Placer.

Table 6.2-6. IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	C		00237	Set ID - OBR
2	75	EI	R		00216	Placer Order Number
3	75	EI	R		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
5	2	ID	R2		00239	Priority
6	26	TS	O		00240	Requested Date/time
7	26	TS	O		00241	Observation Date/Time
8	26	TS	O		00242	Observation End Date/Time
9	20	CQ	O		00243	Collection Volume
10	60	XCN	O		00244	Collector Identifier
11	1	ID	O	0065	00245	Specimen Action Code
12	60	CE	R2		00246	Danger Code
13	300	ST	R2		00247	Relevant Clinical Info.
14	26	TS	O		00248	Specimen Received Date/Time
15	300	CM	C	0070	00249	Specimen Source
16	80	XCN	R		00226	Ordering Provider
17	40	XTN	R2		00250	Order Callback Phone Number
18	60	ST	O		00251	Placer field 1
19	60	ST	O		00252	Placer field 2
20	60	ST	O		00253	Filler Field 1
21	60	ST	O		00254	Filler Field 2
22	26	TS	O		00255	Results Rpt/Status Chng - Date/Time
23	40	CM	O		00256	Charge to Practice
24	10	ID	R2	0074	00257	Diagnostic Serv Sect ID
25	1	ID	O	0123	00258	Result Status
26	400	CM	O		00259	Parent Result
27	200	TQ	R		00221	Quantity/Timing
28	150	XCN	O		00260	Result Copies To
29	150	CM	C		00261	Parent
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
32	200	CM	O		00264	Principal Result Interpreter
33	200	CM	O		00265	Assistant Result Interpreter
34	200	CM	O		00266	Technician
35	200	CM	O		00267	Transcriptionist

36	26	TS	O		00268	Scheduled Date/Time
37	4	NM	O		01028	Number of Sample Containers
38	60	CE	O		01029	Transport Logistics of Collected Sample
39	200	CE	O		01030	Collector's Comment
40	60	CE	O		01031	Transport Arrangement Responsibility
41	30	ID	R2	0224	01032	Transport Arranged
42	1	ID	O	0225	01033	Escort Required
43	200	CE	O		01034	Planned Patient Transport Comment

Adapted from the HL7 Standard, version 2.3.1

Note: All required fields in the OBR segment, except OBR-2 Placer Order Number shall be copied by Order Placer from the ORM message received from the Order Filler.

6.2.4.2.3   Expected Actions

Order Placer shall accept and register order information transmitted from the Order Filler in the ORM message, assign its unique number to it and convey that number to order Filler in the ORR message. In turn, the Order Filler shall register received Order Placer number and include it into the subsequent communication of order status with Order Placer, as well as procedure-related information to the Image Manager and Acquisition Modality (see sections 6.4 and 6.5).

6.2.4.3   Order Management - Order Status Update

The Order Status Update Message is used by the DSS/Order Filler to notify Order Placer about changes in the status of the order as it is being fulfilled by the DSS/Order Filler.

6.2.4.3.1   Trigger Events

ORM - Department System Scheduler/Order Filler updates an order status (control code = SC).

6.2.4.3.2   Message Semantics

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics.

See section 6.1 of this document for MSH segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2..

Required segments are listed below. Other segments are optional.

ORR	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
ORC	Common Order	4

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Table 6.2-7. IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
5	2	ID	R	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	C		00221	Quantity/Timing
8	200	CM	C		00222	Parent
9	26	TS	R		00223	Date/Time of Transaction
10	120	XCN	O		00224	Entered By
11	120	XCN	O		00225	Verified By
12	120	XCN	O		00226	Ordering Provider
13	80	PL	O		00227	Enterer's Location
14	40	XTN	O2		00228	Call Back Phone Number
15	26	TS	O		00229	Order Effective Date/Time
16	200	CE	O		00230	Order Control Code Reason
17	60	CE	O		00231	Entering Organization
18	60	CE	O		00232	Entering Device
19	120	XCN	O		00233	Action By

Adapted from the HL7 Standard, version 2.3.1

When an Order Status Update (control code = SC) message is received at the Order Placer, the element ORC-5 "Order Status" will contain the reason for the status change. These reason shall be one of the following:

Table 6.2-8. Order Status codes

Value	Description
CM	Order is completed
CD	Order was discontinued
IP	Order is in progress

Adapted from the HL7 Standard, version 2.3.1

6.2.4.3.3   Expected Actions

DSS/Order Filler shall provide Order Placer with status updates on the order. At least the following events shall be noted:

- In Progress – when the first Performed Procedure Step corresponding to the Order has been created;

- Completed – as defined by the Department System Scheduler;
- Discontinued – if DSS/Order Filler discontinues the order after one or more corresponding Procedure Steps has been performed.

6.3 Order Cancel

This section corresponds to Transaction 3 of the IHE Technical Framework: Year 2. Transaction 3 is required for the Order Placer and Department System Scheduler/Order Filler actors.

6.3.1 Scope

This transaction is used to cancel existing orders.Although the HL7 Standard supports a number of ways to change order information, IHE Technical Framework: Year 2 defines changing of orders by both Order Placer and Order Filler as a combination of Order Cancel followed by New Order.

6.3.2 Use Case Roles
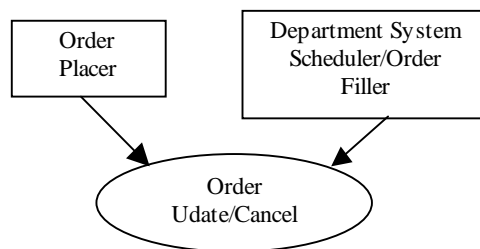
Actor: Order Placer

Role: Cancels orders or receives cancellation requests from the Department System Scheduler/Order Filler.

Actor: Department System Scheduler/Order Filler

Role: Cancels orders or or receives cancellation requests from the Order Placer.

6.3.3 Referenced Standards

HL7 2.3.1 Chapter 4, 7

6.3.4 Interaction Diagram

Order Placer   Department System
                                Scheduler/Order Filler

6.3.4.1 Order Management - Order Cancelled by Order Placer
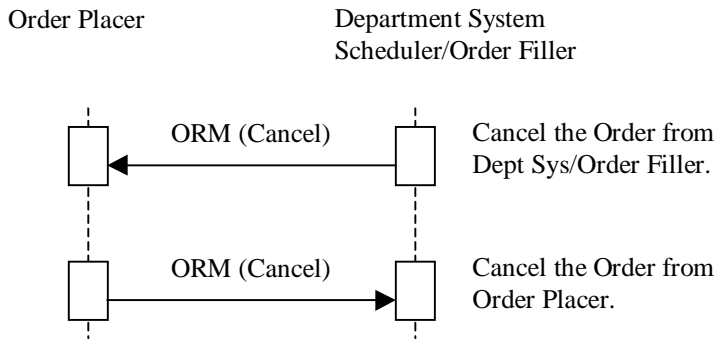
6.3.4.1.1 Trigger Events

ORM – Order Placer cancels an order (control code = CA).

ORM – Order Placer discontinues an order which is currently in-progress (control code = DC).

6.3.4.1.2 Message Semantics

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 standard for general message semantics. Refer to section 6.2.4.1.2 above for detailed requirements of the ORM message.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2.3.

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. The order control codes below shall be supported.

Table 6.3-1. IHE Profile - Supported Order Control Codes

Value	Description	Originator
CA	Cancel order request	P
DC	Discontinue Order request	P

6.3.4.1.3 Expected Actions

After receiving the ORM message with the control code CA, DSS/Order Filler shall discard the record of the order and should not attempt to schedule or otherwise to fulfill it. If the DSS/Order Filler has already scheduled the procedures corresponding to the order, it has to perform Transaction 13 Procedure Update (see section 6.13) to notify the Image Manager of order cancellation.

After receiving the ORM message with the control code DC, DSS/Order Filler shall perform Transaction 13 Procedure Update (see section 6.13) to notify the Image Manager of order discontinuation.

6.3.4.2 Order Management - Order Cancelled by Department System Scheduler/Order Filler

6.3.4.2.1 Trigger Events

ORM – Department System Scheduler/Order Filler cancels the order previously received from Order Placer (control code = OC).

6.3.4.2.2 Message Semantics

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 standard for general message semantics. Refer to section 6.2.4.1.2 above for detailed requirements of the ORM message.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in section 2.3.

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. The order control code below shall be supported.

Table 6.3-2. IHE Profile - Supported Order Control Codes

Value	Description	Originator
OC	Order Cancelled	F

6.3.4.2.3 Expected Actions

After receiving the ORM message with the control code OC, Order Placer shall process the order the same way as if it was cancelled/discontinued by the Order Placer.

If DSS/Order Filler has already scheduled the procedures corresponding to the order, it has to perform Transaction 13 Procedure Update (see section 6.13) to notify the Image Manager of order cancellation.

6.4 Procedure Scheduled

This section corresponds to Transaction 4 of the IHE Technical Framework: Year 2. Transaction 4 is required for the Department System Scheduler/Order Filler and Image Manager actors.

6.4.1 Scope

This transaction specifies a message from the Department System Scheduler/Order Filler to the Image Manager identifying that a procedure has been scheduled.

Scheduling does not necessarily mean precise time assignment for the particular procedures. For example, inpatient procedures are not necessarily scheduled for a specific time slot, but rather for

"today" or "as soon as possible". However, the Department System Scheduler/Order Filler shall handle all orders in such a way that it is capable of informing the Image Manager about procedure timing and resources used to perform a procedure. It must provide the date and time when the procedure is to be performed, although precision of the time portion of that information is allowed to be implementation-dependent.

This message serves as a trigger event for the Image Manager, informing it to obtain necessary information and apply rules to ensure the availability of relevant information to the end user. The Image Manager may need the information to create the Requested Procedure context for its purposes. The Procedure Scheduled transaction includes the initial scheduling message.The Procedure Scheduled message is also used to provide additional information from the Department System Scheduler to the Image Manager for unscheduled cases. In the event that a procedure is performed prior to ordering (as in some of the use cases in section 5.4), this message is used "after the fact" for the Department System Schedule to inform the Image Manager of critical information such as Accession Number and Requested Procedure ID. This is described in more detail within this section.

The Department System Scheduler/Order Filler will need to communicate with multiple Image Managers. The Department System Scheduler/Order Filler shall broadcast these scheduling messages to all Image Managers. An Image Manager shall be able to receive and process these messages with the understanding that the images and MPPS events for these procedures may be sent to a different Image Manager.

6.4.2   Use Case Roles
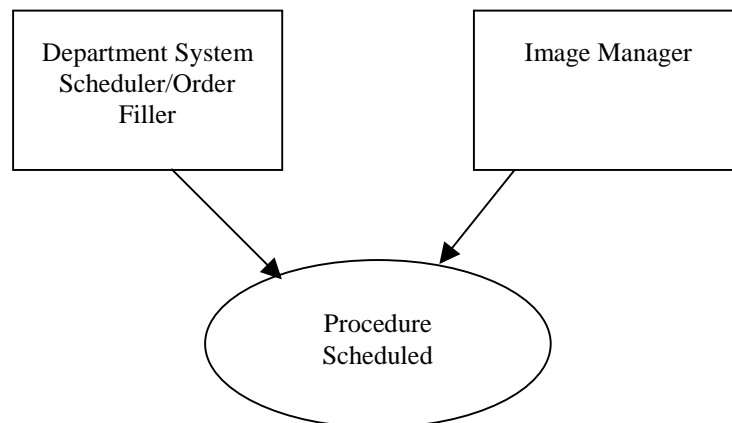
Actor: Department System Scheduler/Order Filler

Role: Enters, modifies and stores information about patients, receives orders, schedules Procedures (exams), modifies information about them (rescheduling, cancellations, code changes, etc.).

Actor: Image Manager

Role: Receives information about Patients, Orders, and schedules, and uses this information to assist in image management.

6.4.3   Referenced Standards

HL7 2.3.1 Chapter 2-4

6.4.4   Interaction Diagram
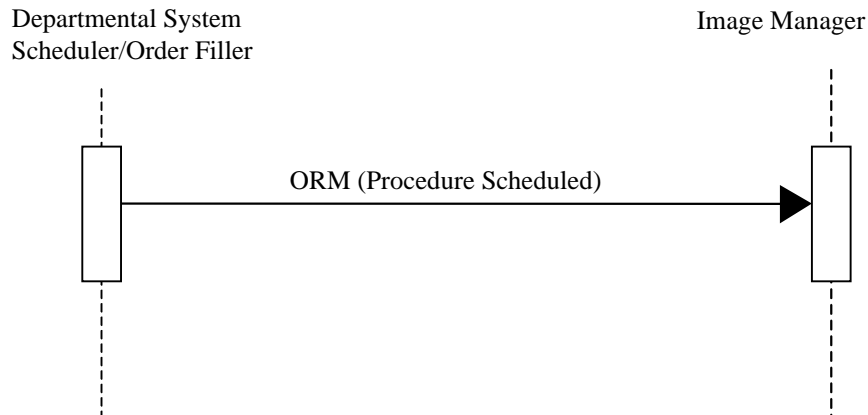
6.4.4.1   Procedure Scheduled Message

6.4.4.1.1   Trigger Events

The Department System Scheduler/Order Filler determines procedures which need to be performed to fill the order, what Procedure Steps need to be performed for each Procedure, and timing and necessary resources.

Note: This transaction should be used when it is the first time that a particular Study Instance UID is being sent from the Department System Scheduler/Order Filler to the Image Manager. If this is not the first usage of a particular Study Instance UID, then Procedure Updated (Transaction 13) should be used.

6.4.4.1.2   Message Semantics

The Department System Scheduler/Order Filler uses an ORM message to convey necessary procedure and scheduling information.

The Procedure Scheduled Transaction will perform the additional task of providing Patient Demographic information to the Image Manager. The Image Manager does not receive all Patient Registration events from the ADT System because it is not necessary for the Image

Manager to be aware of all patients in the enterprise (since most will never have an imaging procedure). The Image Manager shall obtain the Patient Demographic information from the Procedure Schedule ORM, specifically the PID and PV1 segments. For this reason, the Department System Scheduler/Order Filler must complete these segments as described in section 6.1, Patient Registration.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations are given in section 2.3.

6.4.4.1.2.1 ORM Message structure

The segments listed below are required. All other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
{ORC	Common Order	4
OBR}	Order Detail	4
ZDS	Additional identification information (custom for IHE)	

MSH, PID and PV1 Segments are described earlier in section 6.1. The Required and Optional fields described in the Patient Registration Transaction 1 are applicable to the PID and PV1 segments of this transaction.

MSH-9 shall contain the value "ORM".

Table 6.4-1. IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	22	EI	O		00218	Placer Group Number
5	2	ID	R	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	R		00221	Quantity/Timing
8	200	CM	O		00222	Parent
9	26	TS	O		00223	Date/Time of Transaction
10	120	XCN	R2		00224	Entered By
11	120	XCN	O		00225	Verified By
12	120	XCN	R2		00226	Ordering Provider
13	80	PL	R2		00227	Enterer's Location

14	40	XTN	R2		00228	Call Back Phone Number
15	26	TS	O		00229	Order Effective Date/Time
16	200	CE	O		00230	Order Control Code Reason
17	60	CE	R2		00231	Entering Organization
18	60	CE	O		00232	Entering Device
19	120	XCN	O		00233	Action By

Adapted from the HL7 Standard, version 2.3.1

The Department System Scheduler uses the ORM message in a context that is different from the context existing between Order Placer and Order Filler. The Department System Scheduler/Order Filler shall send as many ORM messages as there are Requested Procedures identified to fill a single order. Each ORM message shall contain as many ORC/OBR pairs as there are Action Items in all Scheduled Procedure Steps for that Requested Procedure.

It is actually common for the Department System Scheduler/Order Filler to receive a single ORM from the Order Placer system, but choose to expand that order into multiple Requested Procedures, therefore sending multiple ORMs to the Image Manager.Taking this into account, the Department System Scheduler will consider itself an "order placer" in relation to the Image Manager.

Required fields in the ORC segment shall be filled by the Department System Scheduler as given in the following table.

Table 6.4-2. DSS Mappings of the ORC Segment

Element Name	Seq	Element Shall Contain:	Notes
Order Control Code	ORC-1	"NW"	New order
Placer Order Number	ORC-2	Placer Order Number received from Order Placer	In the event that the Order Filler places the order, the Order Filler shall not send the scheduling ORM message until it has received the Placer Order Number from the Order Placer (through an ORR message).
Filler Order Number	ORC-3	Filler Order Number	Number generated internally by the Department System Scheduler
Order Status	ORC-5	"SC"	Scheduled
Quantity/Timing	ORC-7	Date and time of the Scheduled Procedure Step (in the fourth component)	

Additional information is transmitted in the OBR segment. Per the HL7 Standard, IHE recommends that the fields in ORC and OBR segments given in the following table contain the same information (See table 6.4-3).

Table 6.4-3. Identical Element Mappings between ORC and OBR Segments

Element Name	ORC Segment Element	OBR Segment Element
Placer Order Number	ORC-2	OBR-2
Filler Order Number	ORC-3	OBR-3
Quantity/Timing	ORC-7	OBR-27

The HL7 OBR segment used for this message is described in table 6.4-4.

Table 6.4-4. IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00237	Set ID – OBR
2	75	EI	R		00216	Placer Order Number
3	75	EI	R		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
5	2	ID	R2		00239	Priority
6	26	TS	O		00240	Requested Date/time
7	26	TS	O		00241	Observation Date/Time
8	26	TS	O		00242	Observation End Date/Time
9	20	CQ	O		00243	Collection Volume
10	60	XCN	O		00244	Collector Identifier
11	1	ID	O	0065	00245	Specimen Action Code
12	60	CE	R2		00246	Danger Code
13	300	ST	R2		00247	Relevant Clinical Info.
14	26	TS	O		00248	Specimen Received Date/Time
15	300	CM	C	0070	00249	Specimen Source
16	80	XCN	R2		00226	Ordering Provider
17	40	XTN	R2		00250	Order Callback Phone Number
18	60	ST	R		00251	Placer field 1
19	60	ST	R		00252	Placer field 2
20	60	ST	R		00253	Filler Field 1
21	60	ST	O		00254	Filler Field 2
22	26	TS	O		00255	Results Rpt/Status Chng - Date/Time
23	40	CM	O		00256	Charge to Practice
24	10	ID	R	0074	00257	Diagnostic Serv Sect ID
25	1	ID	O	0123	00258	Result Status
26	400	CM	O		00259	Parent Result
27	200	TQ	R		00221	Quantity/Timing
28	150	XCN	O		00260	Result Copies To
29	150	CM	O		00261	Parent
30	20	ID	R2	0124	00262	Transportation Mode

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31	300	CE	R2		00263	Reason for Study
32	200	CM	O		00264	Principal Result Interpreter
33	200	CM	O		00265	Assistant Result Interpreter
34	200	CM	O		00266	Technician
35	200	CM	O		00267	Transcriptionist
36	26	TS	O		00268	Scheduled Date/Time
37	4	NM	O		01028	Number of Sample Containers
38	60	CE	O		01029	Transport Logistics of Collected Sample
39	200	CE	O		01030	Collector's Comment
40	60	CE	O		01031	Transport Arrangement Responsibility
41	30	ID	O	0224	01032	Transport Arranged
42	1	ID	O	0225	01033	Escort Required
43	200	CE	O		01034	Planned Patient Transport Comment

Adapted from the HL7 Standard, version 2.3.1

Other required fields in the OBR segment shall be filled by the Department System Scheduler as defined in the following table.

Table 6.4-5: DSS mappings of the OBR Segment

Element Name	Seq	Shall Contain:	Notes
Placer Field 2	OBR-19	Requested Procedure ID	All OBR segments within a single ORM message shall have the same value in this field.
Filler Field 1	OBR-20	Scheduled Procedure Step ID	If a Scheduled Procedure Step has multiple Action Items, several ORC segments within a single ORM message may have the same value in this field.
Placer Field 1	OBR-18	Accession Number	
Universal Service ID	OBR-4	Both the Requested Procedure Description /Code and the Scheduled Procedure Step Description/Action Item Code.	Components 1-3 of OBR-4 shall be copied by the Order Filler from the components 1-3 of OBR-4 it obtains from the ORM message (OBR segment) conveyed to it by the Order Placer. Components 4-6 shall be filled with the Scheduled Procedure Step Description/Action Item Code. Components 1-3 of OBR-4 field shall have the same value within one ORM message.
Specimen Source	OBR-15	The fifth component,Site Modifier, shall be used for the L/R indicator. The L/R value shall be appended to the Requested Procedure Description (0032,1060).	This element shall only be used if the coding scheme which is employed does not contain laterality within the coding scheme itself. If laterality is inherent in the coding scheme, this element shall not be sent.
Diagnostic Service Section ID	OBR-24	DICOM Modality	The Modality attribute of DICOM consists of Defined Terms which should be used in this element.

A custom ZDS Segment is defined to convey information generated by the Order Filler and not currently defined in the HL7 standard and is given in the following table.

Table 6.4-6. IHE Profile - ZDS Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	200	RP	R		Z0001	Study Instance UID

Components of the Study Instance UID field shall be encoded as given in the table 6.4-7.

Table 6.4-7. Z Segment Study Instance UID Element Components

Component Number	Component Name	Shall Contain:
1	Reference Pointer	DICOM compliant Study Instance UID value
2	Application ID	Implementation specific
3	Type of Data	"Application"
4	Subtype	"DICOM"

6.4.4.2   Expected Actions

6.4.4.2.1   Use Cases

The intent of this section is to illustrate, using use cases, how key information is used in a Procedure Scheduled transaction.

See section 5.1 (Typical Process Flow) for illustrations of the following discussions:

- Section 5.1.2.1: In the case where the patient demographics are updated or patients are merged prior to placer order creation, this transaction occurs normally using the updated patient and visit information.

- Section 5.1.2.2: In the case where the patient demographics are updated or patients are merged after a procedure has been scheduled, only a Patient Update transaction is required, and this transaction is not affected.

- Section 5.1.3: In the case where an order is cancelled at the Order Placer or Order Filler and a new order is generated, the previously scheduled order (ORM) sent to the Image Manager should be cancelled (see section 6.13) and a new Procedure Scheduled transaction should be initiated for the "new" order.

See section 5.4 (Unidentified Patient Image Acquisition) for illustrations of the following discussions:

- Case 1: In the case where a Temporary Patient Name and ID are assigned by an ADT system and an order is placed at the Order Placer, a Procedure Update transaction is not necessary (only a Patient Update transaction is necessary).

- Case 2: In the case where a Temporary Patient Name and ID are assigned by an ADT system but the order is placed at the Department System Scheduler, a Procedure Update transaction is not necessary (only a Patient Update transaction is necessary).

In both cases 1 and 2, the DICOM attribute information mapping given in the Procedure Scheduled Transaction remains the same. That is, the Study Instance UID, Requested Procedure ID, Accession Number, etc., are supplied by the Department System Scheduler, are used by the modality and Image Manager, and are not changed.

- Case 3: In this case a Temporary Patient Name and ID are assigned by an ADT system, no order is placed prior to image acquisition, but rather an order is placed after the exam is completed, the Study Instance UID is generated by the acquisition modality, and a Modality Performed Procedure Step is sent to the Image Manager and Department System Scheduler (containing the modality generated Study Instance UID). As always, the Study Instance UID contained within an object set remains the "master" key.

  At this point, a Procedure Scheduled transaction (Control Code = NW) must be sent to the Image Manager using the Study Instance UID contained in the MPPS message from the acquisition device. In this case, the information given in table 6.4-8 must be altered by the Image Manager using the information received in the Procedure Update ORM by changing the DICOM objects.

Table 6.4-8. Data Mapping from ORM by Image Manager after Procedure Scheduled

Attributes Overwritten in DICOM Instances Based on Procedure Scheduled information
Placer Order Number + Issuer
Filler Order Number + Issuer
Accession Number
Requested Procedure ID

It should be noted that in case 3, the reconciliation of Scheduled Procedure Steps which are identified by the Department System Scheduler and contained in the Procedure Scheduled message with the Performed   Procedure Steps that are actually contained in the DICOM objects (MPPS object) may not be consistent and do not need to be coerced At this point, the number and identification of the Scheduled Procedure Steps is irrelevant because the procedure has already been performed.

If a race condition should occur such that the Department System Scheduler has just created a Procedure Scheduled Transaction (and generated a Study Instance UID) and the Modality has generated DICOM objects (and generated a different Study Instance UID) it is the responsibility of the Department System Scheduler to reconcile these transactions by canceling the order (and Study Instance UID) that it generated internally and create a new Procedure Scheduled transaction using the Study Instance UID generated by the modality and provided in the Modality Performed Procedure Step transaction.   If it is a multimodality study with multiple

Study Instance UIDs then multiple Procedure Scheduled transactions must be generated by the Department System Scheduler. The studies may still be reported as one Requested Procedure (see sections 6.24-6.27).

In case 3, a Patient Update Transaction(s) must still be sent to the Image Manager to update the patient demographic, visit information, and ID.

- Case 4: In the case where a Department Temporary Patient Name and ID are assigned by the Departmental System Scheduler and the procedure is scheduled, a Procedure Scheduled transaction is necessary and adequately provides the Study Instance UID and other information given in table 6.4-8.   Subsequently, a Patient Update transaction(s) is necessary.

- Case 5: In the case where no Temporary Patient Name nor ID are assigned by an ADT system, no order is placed in advance, but rather the patient is registered at the Department System Scheduler and the order is placed after the exam is complete a Procedure Scheduled transaction (Control Code = NW) must be sent to the Image Manager. Similar to case 3, the Study Instance UID obtained in the Modality Performed Procedure Step message should be used as the key by both the Department System Scheduler and the Image Manager.   The information given in table 6.4-8 must be altered by the Image Manager using the information received in the Procedure Scheduled ORM.

  In case 5, a Patient Update Transaction(s) must still be sent to the Image Manager to update the patient demographic, visit information and ID.

6.5　Modality Worklist Provided

This section corresponds to Transaction 5 of the IHE Technical Framework: Year 2. Transaction 5 is required for the Department System Scheduler/Order Filler Actor and the Acquisition Modality Actor.

6.5.1　Scope

This transaction takes place at the Acquisition Modality at the point of scan/acquisition by a technologist. When a patient arrives for the scheduled procedure, the technologist performing the procedure must examine key information elements as they relate to the procedure, the correctness of the procedure that has been ordered, and comments that may have been entered by the referring physician and/or radiologist, among others. The technologist at the Acquisition Modality uses the DICOM Modality Worklist to query the Department System Scheduler/Order Filler for Scheduled Procedure Steps. The list is downloaded to the Acquisition Modality and the technologist verifies the information on the Acquisition Modality console. In the Modality Images Stored transaction this information will be included in the header of the generated images (See section 6.8 and appendix C).

6.5.2   Use Case Roles
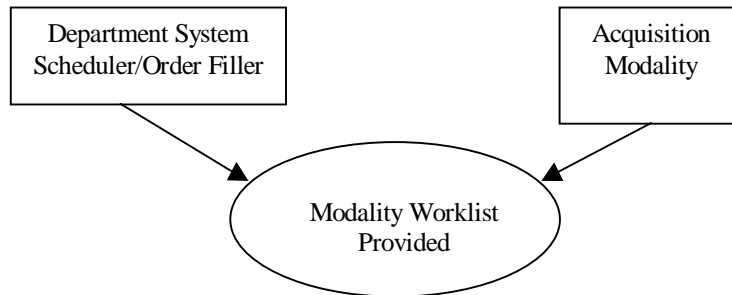
Actor: Acquisition Modality

Role: Responsible for requesting and receiving data from the Department System Scheduler/Order Filler, with the ability to validate the data and correct some discrepancies.
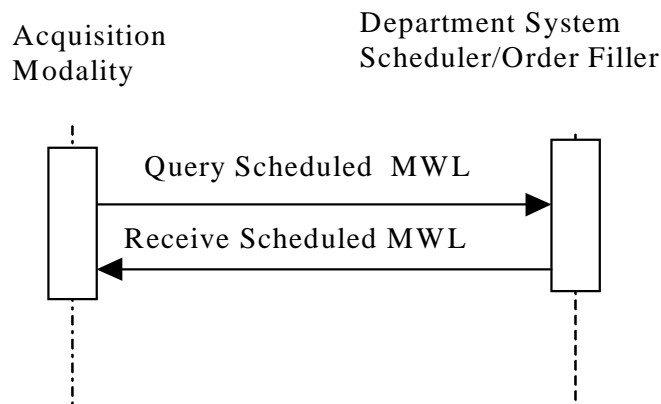
Actor: Department System Scheduler/Order Filler

Role: Responsible for accepting requests for MWL from an acquisition modality, performing the query, and sending the response back.

6.5.3   Referenced Standards

DICOM 1999 PS 3.4: Modality Worklist SOP Class

6.5.4   Interaction Diagram

6.5.4.1   Query Scheduled MWL Message

This is the worklist query message sent to the Department System Scheduler/Order Filler.

6.5.4.1.1   Trigger Events

The patient arrives at the Acquisition Modality for a procedure.

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6.5.4.1.2   Message Semantics

The Acquisition Modality uses the C-FIND Request of the DICOM Modality Worklist SOP Class to query for the worklist from the DSS/Order Filler. The Acquisition Modality performs the SCU role, and the DSS/Order Filler the SCP role.

At least one of the following cases shall be implemented by the Acquisition Modality:

1. The Patient Based Query: Query for a worklist specific for a particular patient. The SCU shall support all (15) combinations of the matching key attributes listed in table 6.5-1 by including 1 or more keys.

Table 6.5-1. MWL Keys for Query by Patient

Matching Key Attributes	Tag
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Accession Number	(0008,0050)
Requested Procedure ID	(0040,1001)

2. The Broad Query: Query for a broad worklist. The SCU shall support all (7) combinations of the matching key attributes listed in table 6.5-2 by including 1 or more keys.

Table 6.5-2. MWL Keys for Broad Worklist Queries

Matching Key Attributes	Tag
Scheduled Procedure Step Start Date	(0040,0002)
Modality	(0008,0060)
Scheduled Station AE-Title	(0040,0001)

6.5.4.1.2.1   Examples for the Use of Matching Key Attributes

- Using the Scheduled Procedure Step Start Date: query for all the procedures in my department that are scheduled for the start date specified.
- Using the Modality key: query for all the procedures that are scheduled on this type of modality (e.g., all CT exams).
- Using AE Title key: query for all the procedures that are scheduled on the modality with the specified AE Title.
- Using the Scheduled Procedure Step Start Date and Modality keys: query for all the CT procedures that are scheduled for today.

Note: DICOM defines that dates and times are matched by their meaning, not as literal strings. If an application is concerned about how a single value matching of dates and times is performed by another application, it may consider using range matching instead (e.g. "<today>-<today>"), which is always performed by meaning.

Note: Applications are recommended to append a wildcard "*" at the end of each component of the structured Patient Name to facilitate matching with both structured and unstructured Patient Names.

6.5.4.1.2.2   Matching Keys and Return Keys for Display

The Modality is required to query for specific attributes (return keys) that will be inserted into the image objects. The requirements for the attributes in the stored images are defined in section 6.8 and appendix C. There are additional attributes which may be queried for use on the Acquisition Modality but might not be inserted into the composite image object.

Table 6.5-3 summarizes the matching key requirements and lists the optional and required attributes that may be requested and should be returned in order to make these available to the user at the Acquisition Modality. See section 2.2 for more information on the requirements expressed in this table. All display requirements are an addition to the DICOM Standard requirements for the Modality Worklist SOP Class.

Table 6.5-3. Return and Matching Keys For Modality Worklist

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Scheduled Procedure Step					
Scheduled Procedure Step Sequence	(0040,0100)	R+	R	R+*	R
>Scheduled Station AE Title	(0040,0001)	R+	R	R+*	R
>Scheduled Procedure Step Start Date	(0040,0002)	R+	R	R+	R
>Scheduled Procedure Step Start Time	(0040,0003)	O	R	R+	R
> Scheduled Procedure Step Location	(0040,0011)	O	O	O	O
>Modality	(0008,0060)	R+	R	R+	R
>Scheduled Performing Physician's Name	(0040,0006)	O	O	O	R
>Scheduled Procedure Step ID	(0040,0009)	O	O	R+*	R
>Scheduled Action Item Code Sequence	(0040,0008)	O	O	R+*	R
>>Code Value	(0008,0100)	O	O	R+*	R
>>Coding Scheme Version	(0008,0103)	O	O	O	O
>>Coding Scheme Designator	(0080,0102)	O	O	R+*	R
>>Code Meaning	(0080,0104)	O	O	R+*	R+
>Scheduled Procedure Step Description	(0040,0007)	O	O	R+	R
Requested Procedure					
Requested Procedure Comments	(0040,1400)	O	O	O	O
Requested Procedure	(0032,1060)	O	O	R+	R

Description						
Requested Procedure Code Sequence	(0032,1064)	O	O	R+*	R
>Code Value	(0008,0100)	O	O	R+*	R
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R
>Code Meaning	(0008,0104)	O	O	R+*	R+
Requested Procedure ID	(0040,1001)	R+	R+	R+	R
Names of Intended recipients of results	(0040,1010)	O	O	O	O
Study Instance UID	(0020,000D)	O	O	R+*	R
Referenced Study Sequence	(0008,1110)	O	O	R+*	R
>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
Imaging Service Request					
Imaging Service Request Comments	(0040,2400)	O	O	O	O
Accession Number	(0008,0050)	R+	R+	R+	R+
Requesting Physician	(0032,1032)	O	O	O	R
Requesting Service	(0032,1033)	O	O	O	O
Referring Physician's Name	(0008,0090)	O	O	R+	R
Visit Identification					
Admission ID	(0038,00100	O	O	O	R
Visit Status					
Current Patient Location	(0038,0300)	O	O	O	R
Visit Relationship					
Referenced Patient Sequence	(0008,1120)	O	O	O	R
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
Other Patient ID's	(0010,1000)	O	O	O	O
Patient Demographic					
Patients Birth Date	(0010,0030)	O	O	R+	R
Patient's Sex	(0010,0040)	O	O	R+	R
Confidentiality constraint on patient data	(0040,3001)	O	O	O	R
Ethnic Group	(0010,2160)	O	O	O	O
Patient Comment	(0010,4000)	O	O	O	O
Patient Medical					
Patient State	(0038,0500)	O	O	O	R

Pregnancy Status	(0010,21C0)	O	O	O	R
Medical Alerts	(0010,2000)	O	O	O	R
Additional Patient History	(0010,21B0)	O	O	O	O
Contrast Allergies	(0010,2110)	O	O	O	R
Patient Weight	(0010,1030)	O	O	O	R
Special Needs	(0038,0050)	O	O	O	R

Note: The attribute entries marked with R+[*] are not required to be displayed. These attributes are partly needed to fulfill the requirements for attributes to be inserted in the image headers (see appendix C), and another part may be used to guide the settings of parameters for the image acquisition. Optionally these attributes may also be displayed.

6.5.4.1.3   Expected Actions

The Departmental System Schedule/Order Filler performs the query and sends the DICOM Modality Worklist to the Acquisition Modality.

6.5.4.2   Receive Scheduled MWL Message

This is the message that the Department System Scheduler sends to the modality as a reply containing DICOM Modality Worklist information.

6.5.4.2.1   Trigger Events

The Departmental System Scheduler/Order Filler had received a query for a MWL.

6.5.4.2.2   Message Semantics

C-FIND Response from the DICOM Modality Worklist SOP Class will be used for this message. Some of the attributes which are queried through the MWL SOP class originate with the Order Placer while other attributes are managed internally by the Department System Scheduler/Order Filler. The DSS/Order Filler will determine the Requested Procedures needed to fulfill the Order, and decompose the Requested Procedures in Scheduled Procedure Steps and Action Items. Coded Values shall be used to specify exactly what actions are to be performed at the Acquisition Modality. In addition to these Coded Values additional instructions for the technologist may be specified. It is recommended to use the Scheduled Procedure Step Description and the Requested Procedure Description attributes for these additional specific instructions.

Appendix D defines the origin and mappings of the attributes returned in a MWL query.

The details of the C-FIND Response from the DICOM MWL SOP Class are depicted in table 6.5-3 and appendix C. At the time images are being created/generated, these attributes will be stored into the DICOM image instance headers. Additional information may be needed by the Acquisition Modality; however this is beyond the scope of this document. Refer to appendix A for a discussion of Accession Number and Procedure ID.

An Order may be cancelled after the corresponding Requested Procedure(s) and Scheduled Procedure Steps have been scheduled, and possibly even after a Performed Procedure Step has been started. In this case the Department System Scheduler/Order Filler shall remove the Scheduled Procedure Steps of the Order from its worklist, and the absence of these Scheduled Procedure Steps in the next C-FIND response to the Acquisition Modality will indicate that the procedure has been cancelled. In this way the technologist recognizes that the previously scheduled steps don't have to be performed.

6.5.4.2.3 Expected Actions

The technologist checks for the existence of the Scheduled Procedure Steps, validates the displayed patient and procedure information, and checks the given instructions.

6.6 Modality Procedure Step In Progress

This section corresponds to Transaction 6 of the IHE Technical Framework: Year 2.

Transaction 6 is required for the Department System Scheduler/Order Filler, Image Manager, Performed Procedure Step Manager and Acquisition Modality actors.

6.6.1 Scope

This transaction includes a message from the Acquisition Modality to the Performed Procedure Step Manager, which in turn issues the message to the Department System Scheduler/Order Filler and the Image Manager that the Performed Procedure Step is in progress. This may be an unscheduled procedure step. The Performed Procedure Step Manager must support forwarding messages to two different destinations. It shall start issuing messages to the configured destinations immediately after it accepts the corresponding messages from the Acquisition Modality.

Implementations of the Image Manager and Department System Scheduler/Order Filler shall include a Performed Procedure Step Manager module to forward messages to the other party. To allow for proper integration, the following considerations must be taken into account:

- Performed Procedure Step Manager must maintain proper PPS objects and then store them until corresponding N-CREATE and N-SET messages are transmitted to both the Image Manager and the Department System Scheduler/Order Filler. If transmission to one or both destinations fails, the Performed Procedure Step Manager shall try to repeat transmission periodically until it succeeds. The Performed Procedure Step Manager must not use failure of one or more of these transmissions as a reason for rejecting the initial transmission from the Acquisition Modality;

- If both the Image Manager and the Department System Scheduler/Order Filler incorporate the Performed Procedure Step Manager function, an infinite redistribution of PPS messages is possible. The Image Manager and the Department System Scheduler/Order Filler systems that provide the Performed Procedure Step Manager function shall be configurable to disable this function;

- When the Performed Procedure Step Manager is implemented along with the Image Manager or the Department System Scheduler/Order Filler, transfer of the information to the system it is integrated with is outside the scope of the IHE Technical Framework (i.e., internal to an implementation). The system with which the Performed Procedure Step Manager is integrated shall be considered one of the two configured destinations.

6.6.2 Use Case Roles
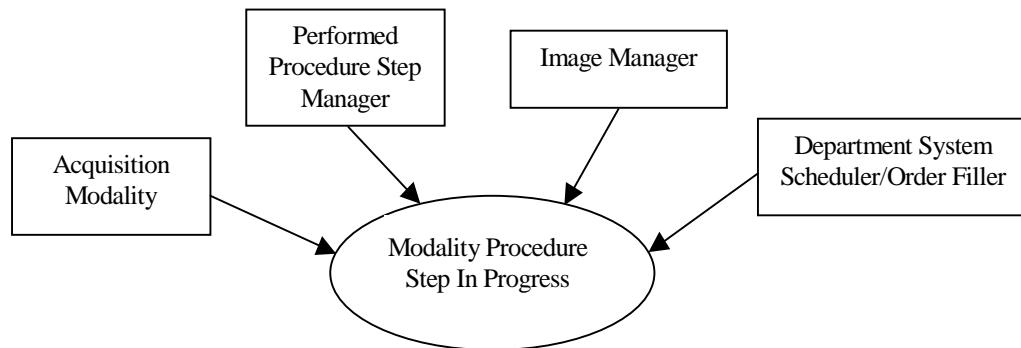
Actor: Department System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Acquisition Modality.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step has started.
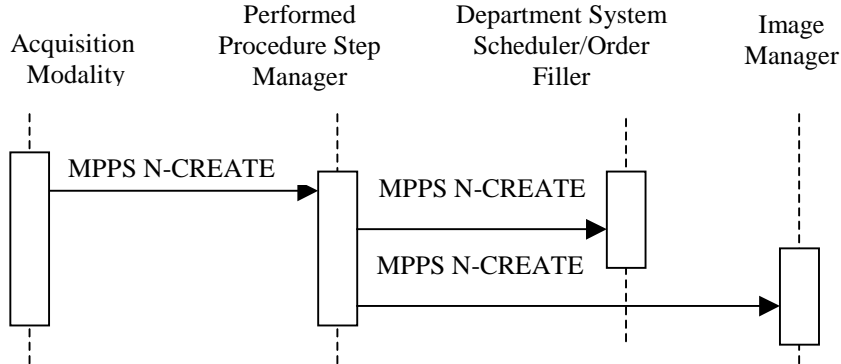
Actor: Performed Procedure Step Manager.

Role: Accepts Performed Procedure Step information from an Acquisition Modality and transmits it to the Department System Scheduler/Order Filler and Image Manager.

6.6.3 Referenced Standards

DICOM 1999 PS 3.4: Modality Performed Procedure Step SOP Class.

6.6.4 Interaction Diagram

6.6.4.1 Procedure Step In Progress Message

6.6.4.1.1 Trigger Event

Technologist begins procedure step from the Acquisition Modality console.

6.6.4.1.2 Message Semantics

The Acquisition Modality uses the Modality Performed Procedure Step SOP Class (N-CREATE Service) to inform the Performed Procedure Step Manager that a specific Procedure Step has been started and is in progress. In turn, the Performed Procedure Step Manager uses the N-CREATE service to forward the information to the Department System Scheduler/Order Filler and Image Manager. The Performed Procedure Step Manager shall use the same Performed Procedure Step SOP Instance UID during this interchange. The following aspects shall be taken into the account during implementation of this step:

6.6.4.1.2.1 Patient/Procedure/Scheduled Procedure Step Information

The Acquisition Modality shall ensure that the Patient/Procedure/Scheduled Procedure Step information it has is valid and current.

6.6.4.1.2.2 Required Attributes

Appendix C lists a number of attributes that have to be properly handled by the Acquisition Modality to ensure consistency between the Performed Procedure Step object attributes, Scheduled Step information in the Modality Worklist, and the information included into the generated images.

6.6.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps

The relationship between Scheduled and Performed Procedure Step information is shown in the following 5 cases. All of these are defined by the DICOM Modality Performed Procedure Step

SOP Class and shall be supported by all the actors involved. Refer to appendix C for details of forming attributes (Study Instance UID, Procedure ID, Accession Number, etc.) in each of these cases.

6.6.4.1.2.3.1 Simple Case
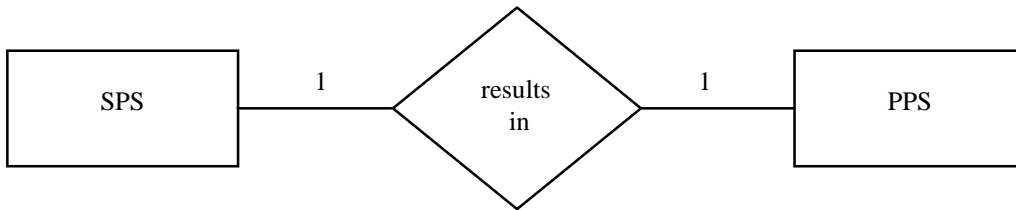
This case indicates a 1-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and Requested Procedure shall be copied from the Scheduled Procedure Step object to the Performed Procedure Step Relationship Module (see appendix C).

6.6.4.1.2.3.2 Unscheduled Case
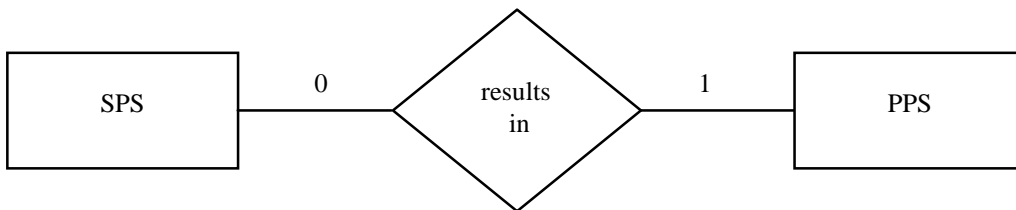
This case indicates a 0-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and, possibly, Requested Procedure is not available to the Acquisition Modality due to different reasons (emergency procedure, Modality Worklist SCP not available, etc.).

The Patient ID entered on the Acquisition Modality by the technologist shall be the one created by the Assigning (Issuer) Authority (refer to appendix G).

6.6.4.1.2.3.3 Append Case

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This is a special case of 1-to-N relationship between SPS and PPS where first the PPS is generated in response to an SPS. Other Performed Procedure Steps are added sequentially at a later time. All Performed Procedure Steps will refer back to the same Requested Procedure and to the original SPS. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module (see appendix C).

6.6.4.1.2.3.4   Group Case
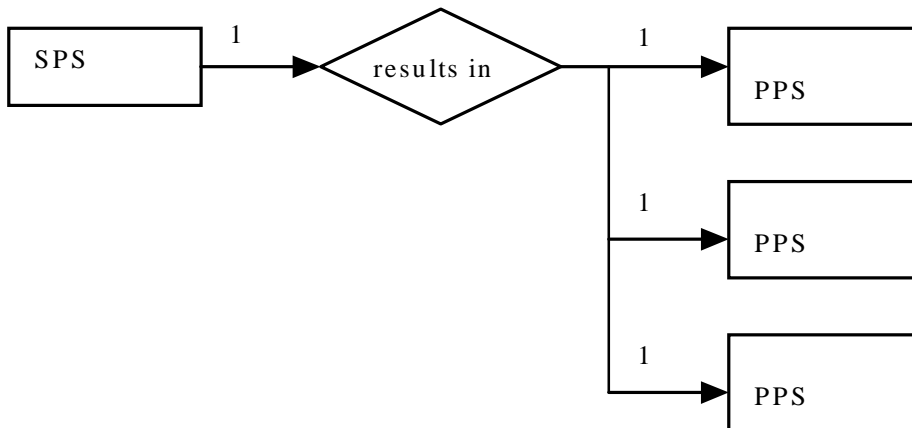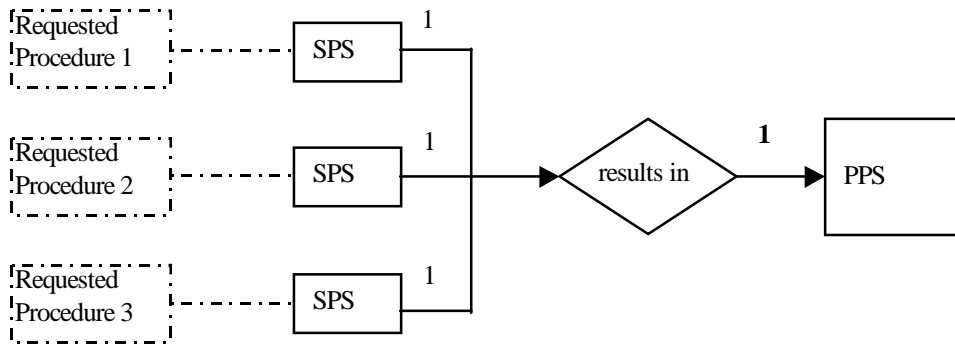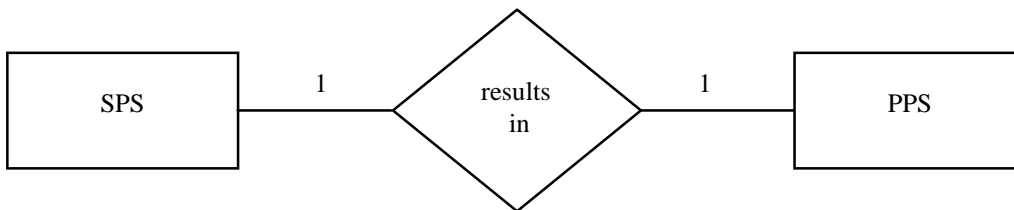

This case indicates an N-to-1 relationship between SPS and PPS. Different SPS may belong to different Requested Procedures or to the same one, and be fulfilled by a single Performed Procedure Step. Refer to section 5.5 for an example of the of the group case in a virtual image set split.

All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the multiple Scheduled Procedure Step Objects to the Performed Procedure Step Relationship Module in the single Performed Procedure Step (see appendix C).

6.6.4.1.2.3.5   Abandoned Case

This case indicates a 1-to-1 relationship between SPS and PPS, even though the PPS may or may not create images. A procedure step may have to be abandoned for clinical reasons when only part of the images may have been acquired. If images are acquired and sent by the Acquisition Modality to the Image Archive, then they shall be identified in the PPS N-SET. This is a means to explicitly communicate this information to the Image Manager or Department System Scheduler/Order Filler. In addition, one may choose to use this abandon case to remove Scheduled Procedure Steps from the worklist, by starting the corresponding Performed Procedure Step and immediately discontinue it using the N-SET service with the status value

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DISCONTINUED. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module (see appendix C).

6.6.4.1.2.4   Protocol Handling

The protocol (a specific combination of modality settings) used in performing a procedure step shall be determined on the Acquisition Modality at this time. Two cases/options are defined: Manual Modality Setting and Assisted Modality Setting. The first case is the one that is currently most commonly used while the second case introduces new functionality and is optional for the IHE Technical Framework: Year 2.

The Acquisition Modality shall not change the Procedure Code it obtains through the MWL. If the Procedure Code is not correct or needs to be changed at the time the procedure is being performed, one of the following two methods shall be used:

- The Procedure Information should be corrected on the Department System Scheduler/Order Filler, and updated information to be downloaded to the Acquisition Modality, OR

- The Acquisition Modality redefines Action Item Codes for the Procedure Steps it actually performs and sets the Procedure Code Sequence (0008,1032) to 0 length.

6.6.4.1.2.4.1   Manual Modality Setting

The following illustration is a Scheduled Procedure Step (SPS) being returned to an Acquisition Modality as part of a Modality Worklist (MWL) and protocol information being returned in the Performed Procedure Step (PPS). In this case an operator selects and sets a protocol based on manual interpretation/evaluation of the Requested Procedure (RP) code and/or the Scheduled Procedure Step Action Item Code (AIC) and description.
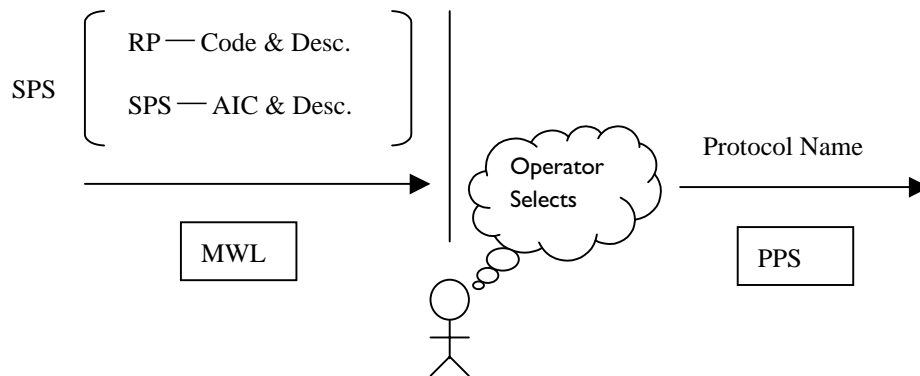

6.6.4.1.2.4.2   Assisted Modality Setting.

The following illustrates a Scheduled Procedure Step (SPS) being returned to an Acquisition Modality as part of a Modality Worklist (MWL) and protocol information being returned in the Performed Procedure Step (PPS) utilizing codes. In this case, the operator may accept the

protocol proposed by the incoming Action Item code, or select a protocol from a table rather than manually entering the protocol as in the Manual Modality Setting.
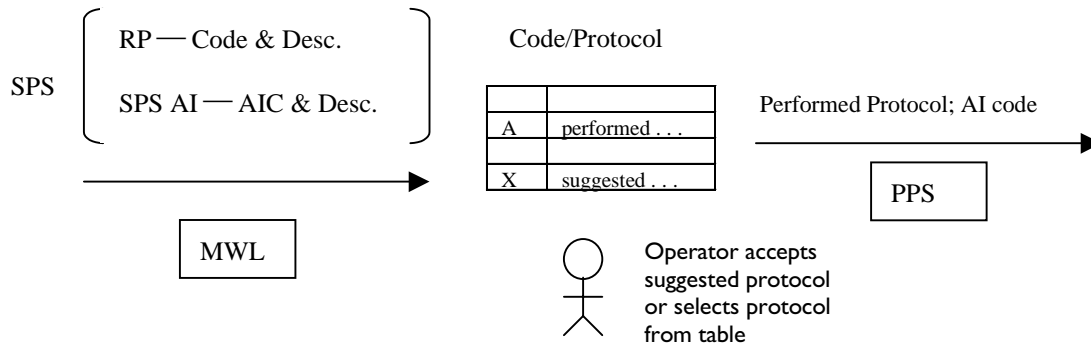
Notes: AI Code/Protocol table will need to be configured on the Acquisition Modality. This table will also need to be synchronized with the Image Manager and the Departmental System Scheduler/Order Filler. If a requested AI Code is not defined, the Acquisition Modality must alert the operator.

6.6.4.1.3   Expected Actions

The DSS/Order Filler receives information from the Performed Procedure Step Manager and links it with the Requested Procedure and Scheduled Procedure Step. If the Requested Procedure ID is transmitted empty (Unscheduled Performed Procedure Step case), the Department System Scheduler/Order Filler and the Image Manager will create an exception which must be manually resolved to link the Performed Procedure Step to the appropriate procedure.

6.7   Modality Procedure Step Completed

This section corresponds to Transaction 7 of the IHE Technical Framework: Year 2.

Transaction 7 is required for the Department System Scheduler/Order Filler, Image Manager, Performed Procedure Step Manager and Acquisition Modality actors.

6.7.1   Scope

This transaction includes a message from the Acquisition Modality to the Performed Procedure Step Manager, which in turn issues messages to the DSS/Order Filler and the Image Manager that the Performed Procedure Step has been completed. Information is not being released for billing at this point but a code may be assigned. The Image Manager may need the information to co-locate images of the same study. The Modality Procedure Step Completed message does not necessarily mean that the set of images is complete or available for retrieval.

6.7.2   Use Case Roles
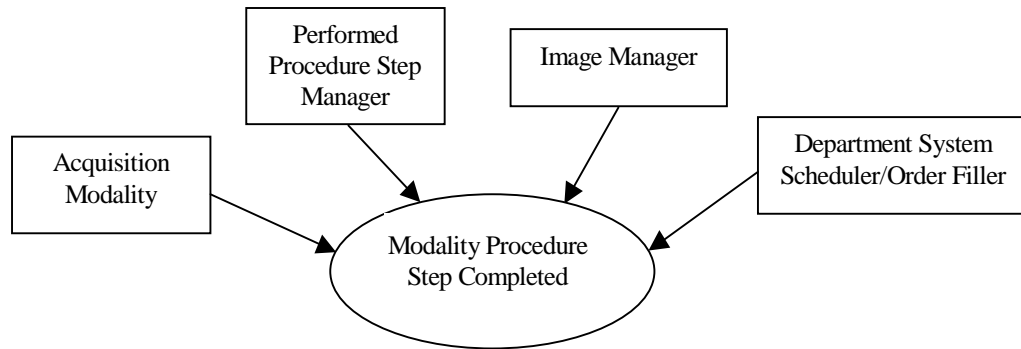
Actor: Departmental System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the PPS Manager. .

Actor: Acquisition Modality.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step is completed.

Actor: Performed Procedure Step Manager.

Role: Accepts Performed Procedure Step information from an Acquisition Modality and transmits it to the Department System Scheduler/Order Filler and the Image Manager.

6.7.3   Referenced Standards

DICOM 1999 PS 3.4: Modality Performed Procedure Step SOP Class.

6.7.4   Interaction Diagram
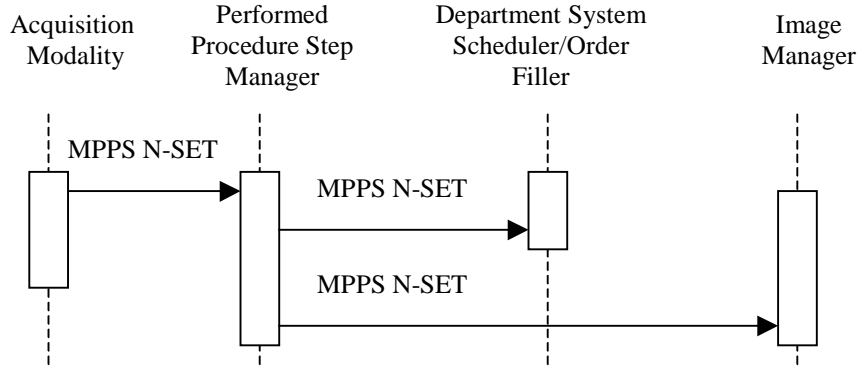

Note: The diagram above shows the sequencing of messages for the Modality Performed Procedure Step SOP Class. Acquisition Modalities will also implement the Storage and Storage Commitment classes. The timing relationship between PPS messages and Storage and Storage Commitment messages is not specified. That is, PPS messages may occur before or after storage requests.

6.7.4.1   Procedure Step Completed/Discontinued

6.7.4.1.1   Trigger Event

Technologist completes procedure step from the Acquisition Modality console.

6.7.4.1.2   Message Semantics

The Acquisition Modality uses the Modality Performed Procedure Step SOP Class (N-SET service) to inform the Performed Procedure Step Manager that a specific Performed Procedure Step has been completed or discontinued. The Acquisition Modality may use the MPPS N-SET service to send intermediate updates of the Performed Procedure Step information.

The final N-SET has either the MPPS status of "COMPLETED" or "DISCONTINUED". The Performed Procedure Step Manager sends corresponding N-SETs to the Department System Scheduler/Order Filler and Image Manager.

Along with other information, the Acquisition Modality shall transmit information about the protocol it used to produce images to the recipients. See Protocol Handling in section 6.6.4.1.2.4 for detailed discussion of this issue.

6.7.4.1.2.1.1   Retrieve AE Title

According to the DICOM Standard, the Acquisition Modality has the ability to include the Retrieve AE Title attribute (0008,0054) in the Performed Series Sequence (0040,0340). This is an AE Title where the referenced image instances for the series may be retrieved. This Retrieve AE Title will often be of zero length or be of short-term validity, due to the following situations:

- If an Acquisition Modality supports a Retrieve SOP Class in an SCP Role, the modality Retrieve AE Title may be included; however, the modality does not guarantee long-term availability.
- A Retrieve AE Title of the Image Manager can be configured on the Acquisition Modality. Otherwise, this field should be sent zero length. Acquisition Modality implementers should not assume that the destination AE Title used for the Storage SCP or Storage Commitment SCP is the same as that for Image Retrieval.
- An Acquisition Modality may receive the Retrieve AE Title in a Storage Commitment Message (N-EVENT REPORT). However, this information may be received well after the MPPS N-SET (Complete) was performed.

6.7.4.1.3   Expected Actions

The Image Manager and Department System Scheduler/Order Filler receive information about the Performed Procedure Step being complete or discontinued. The Image Manager and Department System Scheduler are not required to act on intermediate N-SET messages with the MPPS Status "IN PROGRESS".

The Requested Procedure may be considered complete if all Performed Procedure Steps related to all Scheduled Procedure Steps have been completed (or properly discontinued). Additional new (unscheduled) Performed Steps may be performed at any time, even after the Requested Procedure has been assigned complete scanning status. See relationship between Scheduled and Performed Procedure Steps in section 6.6.4.1.2.3 for detailed discussion of this issue.

6.8   Modality Images Stored

This section corresponds to Transaction 8 of the IHE Technical Framework: Year 2. Transaction 8 is required for the Image Archive and Acquisition Modality.

6.8.1   Scope

In the Modality Images Stored transaction, the Acquisition Modality sends the acquired images to the Image Archive. The information provided from the Modality Worklist transaction (see section 6.5) will be included in the headers of the generated images.

6.8.2   Use Case Roles

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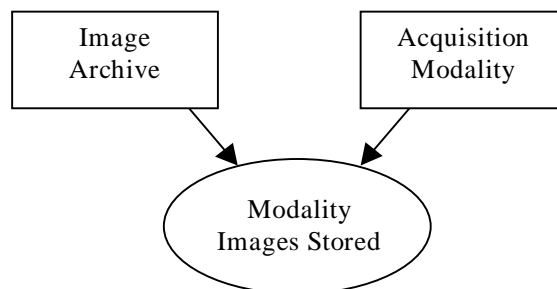
Actor: Acquisition Modality

Role: Transmit acquired image data to Image Archive.

Actor: Image Archive

Role: Accept and store images from Acquisition Modalities.

6.8.3 Referenced Standards

DICOM 1999 PS 3.4: Storage Service Class.

6.8.4 Interaction Diagram
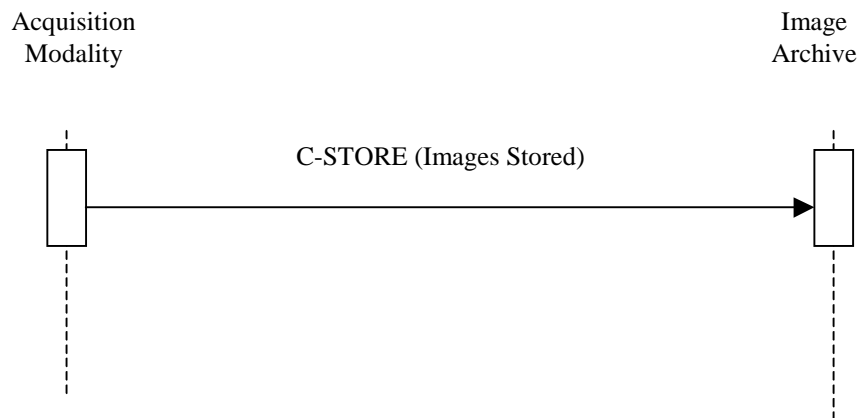
6.8.4.1 Images Stored

6.8.4.1.1 Trigger Events

The Acquisition Modality can transfer images to the Image Archive sequentially within one or more DICOM associations, as the images become available or collectively.

6.8.4.1.2 Message Semantics

The Acquisition Modality uses the DICOM C-STORE message to transfer the images. The Acquisition Modality is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

The technologist validates the available information for the patient and the Scheduled Procedure Step/Requested Procedure. It is a requirement that certain information be recorded in the image header. The details of the mapping to DICOM image instances are depicted in appendix C. Effectively, this appendix strengthens the type definition of some DICOM attributes for the IHE Technical Framework: Year 2.

6.8.4.1.3   Expected Actions

The Image Archive will store the received DICOM objects.

6.8.4.1.3.1   DICOM Image Storage SOP Classes

The DICOM Standard (1999) defines a number of image specific storage SOP classes. It is expected that Image Archive will support multiple storage SOP classes as defined in table 6.8-1 below.

Table 6.8-1. Suggested Image SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage
1.2.840.10008.5.1.4.1.1.128	Positron Emission Tomography Image Storage
1.2.840.10008.5.1.4.1.1.481.1	RT Image Storage
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage
1.2.840.10008.5.1.4.1.1.12.1	X-Ray Angiographic Image Storage
1.2.840.10008.5.1.4.1.1.12.2	X-Ray Radiofluoroscopic Image Storage
1.2.840.10008.5.1.4.1.1.1.1	Digital X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.1.1	Digital X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.77.1.1	VL Endoscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.2	VL Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.3	VL Slide-Coordinates Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.4	VL Photographic Image Storage

6.9   Modality Presentation State Stored

This section corresponds to Transaction 9 of the IHE Technical Framework: Year 2. Transaction 9 is required for the Image Archive Actor and is optional for the Acquisition Modality Actor.

6.9.1   Scope

This section describes DICOM Storage requests of Grayscale Softcopy Presentation States issued by the Acquisition Modality to the Image Archive. The Acquisition Modality sends Presentation States for storage along with the images so they can be later used for support of consistent display of imaging data. The Acquisition Modality will be the DICOM Storage SCU

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and the Image Archive will be the DICOM Storage SCP. DICOM Supplement 33: Grayscale Softcopy Presentation State Storage defines the transformations required for this transaction.

6.9.2   Use Case Roles

```
   ┌─────────────┐              ┌─────────────┐
   │ Acquisition │              │    Image    │
   │  Modality   │              │   Archive   │
   └─────────────┘              └─────────────┘
          \                          /
           \                        /
            ↘                      ↙
              ╭──────────────────╮
             ╱      Modality       ╲
            │  Presentation State   │
             ╲       Stored        ╱
              ╰──────────────────╯
```
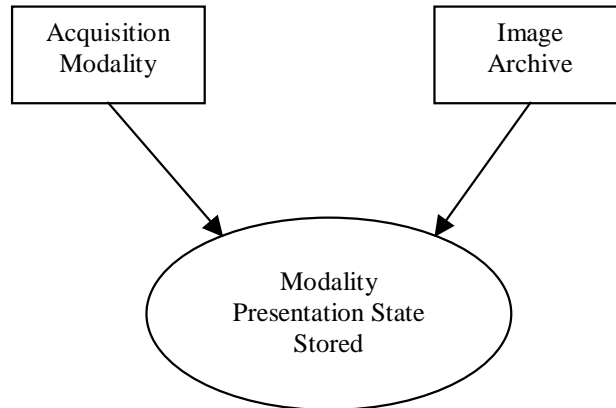
Actor: Acquisition Modality

Role: Generate Grayscale Softcopy Presentation States to be applied to image data. This actor will support the ability to send Presentation State data to an Image Archive. This actor must support pixel rendering according to the Grayscale Standard Display Function (GSDF) as defined in DICOM 1999 PS 3.14.

Actor: Image Archive

Role: Accept and store Grayscale Softcopy Presentation State SOP Instances received from the Acquisition Modality.

6.9.3   Referenced Standards

DICOM 1999 PS 3.4: Storage Service Class

DICOM Supplement 33: Grayscale Softcopy Presentation State Storage (Final Text 21 September 1999)

DICOM 1999 PS 3.14: Grayscale Standard Display Function

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6.9.4   Interaction Diagram

6.9.4.1   Modality Presentation State Stored

6.9.4.1.1   Trigger Events

The Acquisition Modality generates a Grayscale Softcopy Presentation State and sends it to the Image Archive for storage.

6.9.4.1.2   Message Semantics

The Acquisition Modality uses the DICOM C-STORE message to store Grayscale Softcopy Presentation States. Message semantics are defined in the Grayscale Softcopy Presentation State Storage SOP Class Behavior section of the DICOM Standard (DICOM Supplement 33).

6.9.4.1.3   Expected Actions

The Image Archive will store the received Grayscale Softcopy Presentation State objects.

6.10   Modality Storage Commitment

This section corresponds to Transaction 10 of the IHE Technical Framework: Year 2. Transaction 10 is required for the Image Manager and Acquisition Modality actors.

6.10.1   Scope

In the Modality Images Stored and/or the Modality Presentation States Stored transaction, the Acquisition Modality has sent the acquired images and/or generated Presentation States of a study to the Image Archive. In this Modality Storage Commitment transaction the Acquisition Modality requests that the Image Manager/Image Archive accept responsibility for the images and/or Presentation States. The objective of this transaction is to provide a formal release of storage responsibility by the Acquisition Modality, allowing it to reuse its internal resources allocated to the study.

6.10.2 Use Case Roles
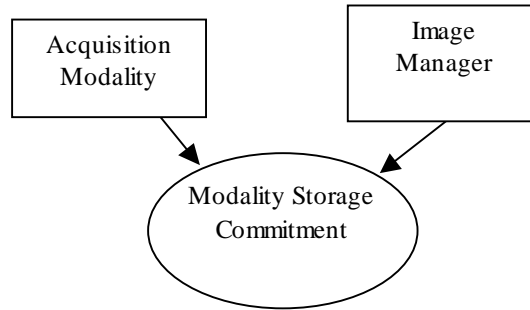
Actor: Acquisition Modality

Role: Make requests for storage commitment to the Image Manager for the images and/or Presentation States previously transmitted.

Actor: Image Manager.

Role: Assume responsibility for reliable storage, retrieval, and validity of image data and Presentation States.

6.10.3 Referenced Standards

DICOM 1999 PS 3.4: Storage Commitment Push Model SOP Class.

6.10.4 Interaction Diagram
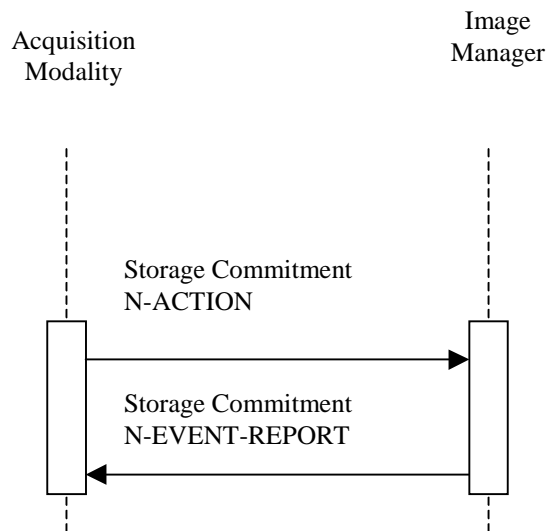
6.10.4.1 Images Committed

The Storage Commitment Push Model SOP Class shall be used as reflected in the interaction diagram. The Storage Commitment Pull Model SOP Class will not be supported. Refer to the DICOM 1999 PS 3.4 for detailed descriptive semantics.

6.10.4.1.1 Trigger Events

The Acquisition Modality is the Storage Commitment SCU and can issue a commitment request at any time after the successful transfer of one or more SOP Instances to the Image Manager, which is the Storage Commitment SCP.

6.10.4.1.2 Message Semantics

The Acquisition Modality uses the DICOM Storage Commitment SOP Class to communicate with the Image Manager. The Acquisition Modality shall not use the Referenced Study Component Attribute because the Modality Performed Procedure Step will be used for this purpose. The Storage Commitment AE Title used by the Image Manager may or may not be the same AE Tile as the one used for the Images Stored (C-STORE) service. The Acquisition Modality shall support this flexibility with respect to the AE Title. The N-EVENT-REPORT sent by the Image Manager to communicate its storage commitment may or may not occur on the same association as the N-ACTION.

An Acquisition Modality may receive the Retrieve AE Title in a Storage Commitment Message (N-EVENT REPORT). However, this N-EVENT REPORT may happen well after the Modality Performed Procedure Step N-SET (Complete) was performed. For this reason, the IHE Technical Framework: Year 2 does not require that the Acquisition Modality send the Retrieve AE Title Attribute (0008,0054) in the Modality Performed Procedure Step N-SET (See section 6.7).

Under normal circumstances, in the event that the Image Manager cannot service the storage commitment request, which can be determined by the "Failure Reason Attribute," the Acquisition Modality shall not delete nor modify the respective SOP instance.

6.10.4.1.3 Expected Actions

The Image Manager in coordination with the Image Archive accepts responsibility for the safe storage of the transferred image data or Presentation States. (The form of the cooperation is beyond the scope of the IHE Technical Framework.) Ownership of data transfers from the Acquisition Modality to the Image Manager. The Acquisition Modality is then free to manage its own internal resources accordingly.

6.11 Image Availability Query

This section corresponds to Transaction 11 of the IHE Technical Framework: Year 2. Transaction 11 is required for the Department System Scheduler and Image Manager actors.

6.11.1　Scope

The purpose of this transaction is for the Department System Scheduler/Order Filler to determine whether images associated with a particular performed procedure step have been stored and are available for use in subsequent workflow steps as well as the storage location for retrieval of these images. The Image Manager is assumed to possess image availability information. The following examples show possible uses of the Image Availability Query:

- The Department System Scheduler/Order Filler queries the Image Manager after receiving notification that images have been acquired (by MPPS N-SET message with PPS status of "COMPLETED" – see Transaction 7) until it receives a list of all images listed in the PPS.

- The Department System Scheduler/Order Filler needs to verify the availability of prior images pre-fetched according to workflow rules. In this case the availability of a single image may have to be verified.

Image availability is determined by the fact that the Image Instance UID in question is returned in response to the query. However, for the purposes of workflow management, image availability shall also be qualified with two additional parameters:

Storage Location describes a system or system component (for instance, an Image Archive) which can be identified as a holder of images at a particular period in time.

Access Time is a period of time that is required for images to be moved from a storage location to be ready for distribution; i.e., this does not take into consideration the outbound network transfer time nor the performance of the receiver application to display the images. The exact access time is difficult to determine and is highly implementation-dependent. Nevertheless, it is possible to approximate access time by using a degree or level of image availability.

6.11.2　Use Case Roles
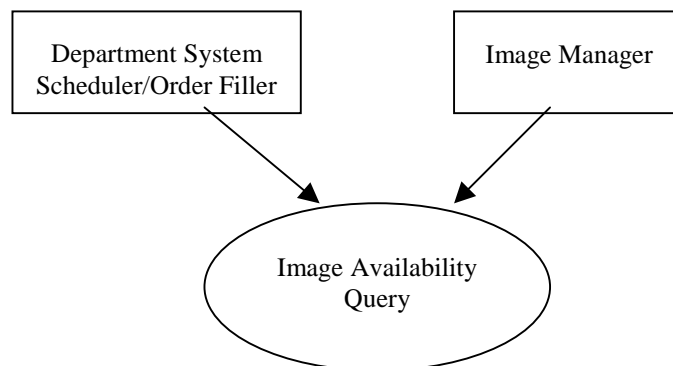
Actor: Department System Scheduler/Order Filler

Role: Queries Image Manager to determine availability of images for use in the processes according to department workflow (for example, interpretation)

Actor: Image Manager

Role: Supplies image availability information to Department System Scheduler/Order Filler

6.11.3   Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class.

6.11.4   Interaction Diagram
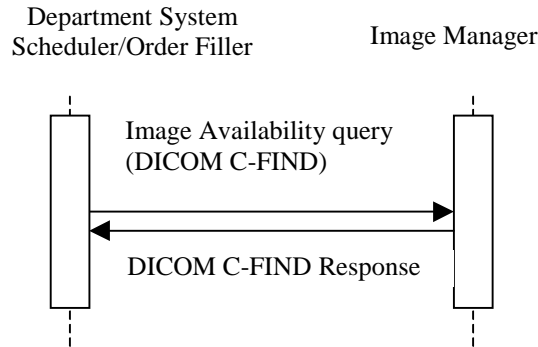
6.11.4.1   Query Image Availability

6.11.4.1.1   Trigger Events

After receiving MPPS N-SET message with PPS status of "COMPLETED" or at a later time, the Department System Scheduler/Order Filler needs to verify image availability.

6.11.4.1.2   Message Semantics

The Department System Scheduler/Order Filler issues a C-FIND request as specified in the DICOM Standard for the Study Root Query/Retrieve Information Model – FIND SOP Class. The Department System Scheduler/Order Filler must be configured with the AE information of the Image Managers to be queried. To obtain the list of images in question, the Department System Scheduler/Order Filler shall perform a query on the Image Level based on the specification in DICOM. The Hierarchical Search Method shall be supported. The following table highlights important attributes of the query. It is not the intent of this transaction to provide a mechanism for polling. The Department System Scheduler/Order Filler shall query the Image Manager with the minimal number of queries necessary. For example, if the purpose is to verify availability of all images in a series, DSS/OF shall not send queries on an image-by-image basis. In this case, a single, zero length value for the SOP Instance UID could be sent, then all matched images information will be returned.

Table 6.11-1. Images Availability Query Keys

Attribute	Tag	Query Key value
Query/Retrieve Level	(0008,0052)	IMAGE
Study Instance UID	(0020,0010)	Unique value for single-value match

Series Instance UID	(0020,000E)	Unique value for single-value match
SOP Instance UID	(0008,0018)	Single value, zero length value or list of UIDs

Per the DICOM standard, Retrieve AE Title (0008,0054) shall be supported and returned by the Image Manager as part of the response.

To better quantify Access Time, IHE has proposed the addition of the attribute Image Access Time with enumerated values of "ON-LINE", "NEAR-LINE" and "OFF-LINE" in a DICOM Change Proposal (CP 191). This is not part of the IHE Technical Framework: Year 2, but will be incorporated into future versions when the correction proposal to the DICOM standard is approved. In terms of access times and results of subsequent Retrieve (C-MOVE) request, the Image Availability values shall be interpreted as follows:

Table 6.11-2. Image Access Time

Level	Description	Access time
ON-LINE	Images can be retrieved from storage location and be ready for distribution within a reasonable period of time (what time is reasonable is implementation-specific)	Typically, seconds to few minutes
NEAR-LINE	Before distribution, images has to be processed at a storage location; total retrieval time is longer than "reasonable"	Typically, minutes to an hour
OFF-LINE	Image cannot be distributed without human user intervention	Typically, minutes to hours to days

6.11.4.1.3 Expected Actions

The Image Manager shall respond to the C-FIND as specified in the DICOM standard, including returning the SOP Instance UIDs (0008,0018) and corresponding Retrieve AE title (0008, 0054) when the match is successful.

6.12 Patient Update

This section corresponds to Transaction 12 of the Technical Framework: Year 2. Transaction 12 is required for the ADT, Order Placer, Department System Database and Image Manager actors.

6.12.1 Scope

This transaction involves changes to patient information, including demographics, patient identification, patient location/class changes, and patient merges. These changes may occur at any time for a patient record. This transaction is used for both inpatients (i.e., those who are assigned a bed at the facility) and outpatients (i.e., those who are not assigned a bed at the facility) if the patient has been previously registered.

6.12.2   Use Case Roles
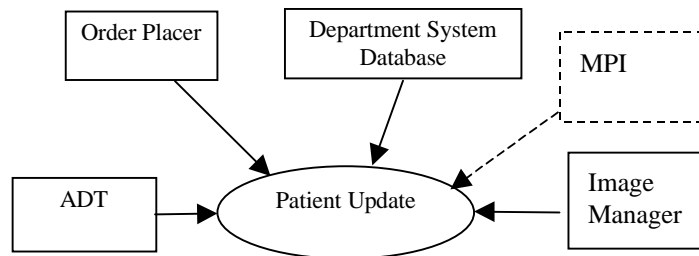
Actor: ADT

Role: Adds and modifies patient demographic and encounter information.

Actor: Order Placer

Role: Receives patient and encounter information for use in order entry.

Actor: Department System Database

Role: Receives and updates patient and encounter information to maintain consistency with ADT and MPI systems. Shall provide the updated patient and encounter information to the Image Manager.

Actor: MPI

Role: Receives patient and encounter information from multiple ADT systems. Maintains unique enterprise-wide identifier for a patient.

Actor: Image Manager

Role: Receives patient and encounter information for use in maintaining image database and, possibly, for image management such as autorouting to a specific in-patient floor.

Note: IHE Technical Framework: Year 2 does not support the use of a Master Patient Index which is required for synchronization of patient information between multiple ADT systems employed by a healthcare enterprise. It is expected that the IHE initiative will include an MPI Actor in the future and that the Patient Update/Merge Transaction between the ADT and MPI will be similar to the transaction between the ADT and Order Placer and Order Filler actors.

6.12.3   Referenced Standards

HL7 2.3.1 Chapters 2, 3

6.12.4   Interaction Diagram
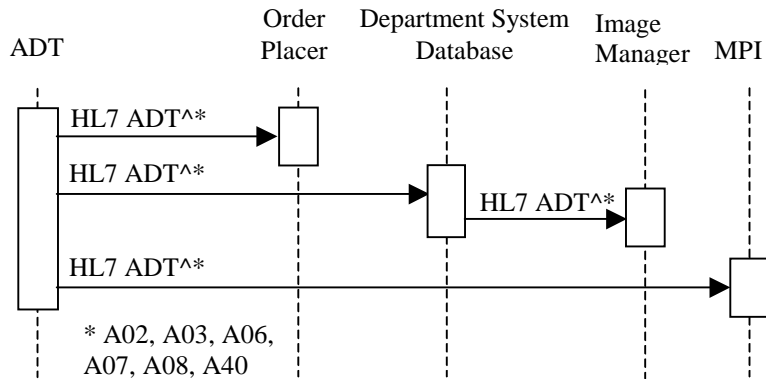
6.12.4.1   Patient Management – Update Patient

6.12.4.1.1   Trigger Events

Changes in patient location result in the following Update Patient message:

> A02 – Patient Transfer

An A02 event is issued as a result of the patient changing his or her assigned physical location.

Changes in patient class (that is from an inpatient status to outpatient, from an outpatient status to inpatient, from "admitted" or "non-admitted" status to discharged) result in one of the following Update Patient messages:

- A03 – Patient Discharge
- A06 – Change an Outpatient to an Inpatient
- A07 – Change an Inpatient to an Outpatient

An A03 event signals the end of a patient's stay in a healthcare facility. For in-patient, it signals that the patient's status has changed to "discharged" and the patient is no longer in the facility. For outpatient, it signals the end of current visit of a patient to the facility. An A06 event is sent when a patient who was present for a non-admitted visit is being admitted. This event changes a patient's status from non-admitted to admitted. An A07 event is sent when a patient who was admitted changes his/her status to "no longer admitted" but is still being seen for this episode of care. This event changes a patient from an "admitted" to a "non-admitted" status.

Changes to patient demographics and account information (e.g., change in patient name, patient address, etc.) shall trigger the following Update Patient message:

- A08 – Update Patient Information

Resolution of the situation where two patient records are found to identify the same person, shall trigger the following Merge Patient messages:

- A40 – Merge Patient – Internal ID

An A40 message indicates that a merge has been done at the internal identifier level. That is, PID-3-patient ID identifier has been merged with MRG-1 Patient ID. This message is initiated by the system that performs the merge.

6.12.4.1.2   Message Semantics

The Update Patient transaction is an HL7 ADT message. The message shall be generated by the system that performs the update whenever an error is resolved or a change occurs in patient demographics, patient class changes, patient location, or whenever two patient records are identified to be the same person.

The segments of the **Update Patient Class** and **Patient Transfer** messages listed below are required, and the detailed description of messages is provided in sections 6.12.4.1.2.1 through 6.12.4.1.2.3.

ADT A02/A03/A06/A07	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

The segments of the **Update Patient Information** message listed below are required, and the detailed description of the message is provided in section 6.12.4.1.2.4. The allergy segment AL1 is optional.

ADT A08	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3
[{AL1}]	Allergy	3

The segments of the **Merge Patient** message listed below are required, and the detailed description of the message is provided in section 6.12.4.1.2.5. The PV1 segment is optional.

ADT A40	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
MRG	Merge Information	3
[PV1]	Patient Visit	3

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The Patient Update transactions shall be acknowledged by the HL7 ACK message sent from the receiver of ADT message to its sender, as defined in section 6.1.

The MSH segment description is given in table 6.1-1; however, the second component of Field *MSH-9 Message Type* shall have the value A02, A03, A06, A07, A08, or A40, as appropriate.

The EVN segment description is given in table 6.1-2.

6.12.4.1.2.1   Patient Transfer message (A02)

Refer to table 6.1-3 for the PID segment and to table 6.1-4 for the PV1 segment definitions.

The "Patient Transfer" (A02) message changes shall include:

> The new patient location shall appear in PV1-3-assigned patient location while the old patient location shall appear in PV1-6-prior patient location.

6.12.4.1.2.2   Update Patient Discharge message (A03)

Refer to table 6.1-3 for the PID segment and to table 6.1-4 for the PV1 segment definitions.

The "Patient Discharge" (A03) message changes shall include:

> The patient's location prior to discharge shall be entered in PV1-3-assigned patient location.

> If the patient is an outpatient, PV1-45-discharge date/time shall be used for the visit end date/time.

6.12.4.1.2.3   Update Patient Class messages (A06/A07)

Refer to table 6.1-3 for the PID segment and to table 6.1-4 for the PV1 segment definitions.

The "Change an Outpatient to an Inpatient" (A06) message changes shall include:

- The new patient class shall appear in PV1-2-patient class.
- The new patient location shall appear in PV1-3-assigned patient location.
- The old patient location (if relevant) shall appear in PV1-6-prior patient location.
- The current active account number shall appear in PID-18-patient account number.
- The Attending Doctor in PV1-7, the Referring Doctor in PV1-8, and the Consulting Doctor in PV1-9, may be different, if there are changes to those values.

The "Change an Inpatient to an Outpatient" (A07) message changes shall include:

- The new patient class shall appear in PV1-2-patient class.
- The old patient location shall appear in PV1-6-prior patient location.
- The current active account number shall appear in field PID-18-patient account number.
- The Attending Doctor in PV1-7, the Referring Doctor in PV1-8, and the Consulting Doctor in PV1-9, may be different, if there are changes to those values.

A06 and A07 messages shall be used exclusively to send fields pertinent to the change in patient class between inpatient and outpatient.

Modification of any patient demographic information or non patient-class visit information must be done by in addition sending an Update Patient Information (A08) message.

6.12.4.1.2.4   Update Patient Information message (A08)

The required fields of the PID, PV1, and AL1 segments are given in tables 6.1-3 through 6.1-5, respectively. All of the required (R and R2) information for a patient record shall be re-sent in an A08 message. Any information received as null (non-existent) in the A08 message shall be removed from the receiving system's database for that patient record.

An A08 message is the only method that may be used to update patient demographic and visit information. However Patient ID cannot be updated with an A08 message. An A40 message shall be used for this purpose (see section 6.12.4.1.2.5).

6.12.4.1.2.5   Merge Patient message (A40)

The required fields of the PID and PV1 segments are given in section 6.1, tables 6.1-3 and 6.1-4, respectively. The MRG segment is given in table 6.12-1 below.

The PID and PV1 segments contain the dominant patient information, including Patient ID (and Issuer of Patient ID). The MRG segment identifies the "old" or secondary patient records to be de-referenced. HL7 does not require that the 'old' record be deleted; it does require that the "incorrect" identifier is never referenced in future transactions following the merge.

A separate merge message shall be sent for each patient record to be merged. For example, if Patients A, B, and C are all to be merged into Patient B, two MRG messages would be sent. In the first MRG message patient B would be identified in the PID segment, and Patient A would be identified in the MRG segment. In the second MRG message, patient B would be identified in the PID segment, and Patient C would be identified in the MRG segment.

Modification of any patient demographic information should be done by sending a separate Update Patient Information (A08) message for the current Patient ID. An A40 message is the only method that may be used to update a Patient ID.

A new Patient shall be created in the Image Manager using the demographics contained in the Patient Merge (A40) message when the prior Patient to be merged does not exist on the Image Manager. This should be followed by a Patient Update (A08) Message to update any of the demographics missing in the Patient Merge (A40) message.

Table 6.12-1. IHE Profile - MRG segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	20	CX	R		00211	Prior Patient Identifier List
2	20	CX	O		00212	Prior Alternate Patient ID
3	20	CX	O		00213	Prior Patient Account Number
4	20	CX	R2		00214	Prior Patient ID
5	20	CX	O		01279	Prior Visit Number
6	20	CX	O		01280	Prior Alternate Visit ID

7	48	XPN	R2		01281	Prior Patient Name

Adapted from the HL7 Standard, version 2.3.1

Modification of any patient demographic information or non patient-class visit information must be done by in addition sending an Update Patient Information (A08) message.

6.12.4.1.3   Expected Actions

For a Patient Transfer, Patient Discharge, or Patient Class message (A02/A03/A06/A07) it is expected that the receiving system will change its local patient visit information.

For a Patient Information message (A08) it is expected that the receiving system will update its local patient demographic, visit, allergy, and/or insurance information. Any information received as null or blank in the new A08 message should be removed locally.

For a Patient Merge message (A40) it is expected that the receiving system will perform updates to reflect the fact that two patient records have been merged into a single record.

6.12.4.2   Patient Management – Cancel Patient Transfer/Discharge

6.12.4.2.1   Trigger Events

The following events will trigger one of the Cancel messages:

- A12 – Transfer of a patient from one location to another has been cancelled due to error in the information or the decision not to transfer patient after all.
- A13 – Discharge of a patient has been cancelled due to error in the information or the decision not to discharge patient after all.

6.12.4.2.2   Message Semantics

Patient Transfer/Discharge conveyed by the HL7 ADT^A02 or ADT^A03 may have to be revoked due to the errors in the information or the decision of not transferring/discharging patient. Cancellation transaction is conveyed by the HL7 ADT^A12 or ADT^A13 messages. ADT^A12 shall be used to revoke transaction conveyed by ADT^A02 message. ADT^A13 shall be used to revoke transaction conveyed by the ADT^A03 message.

6.12.4.2.3   Expected Actions

If the patient record was modified as a result of Patient Transfer/Discharge transaction, it shall be reverted.

6.13   Procedure Update

This section corresponds to Transaction 13 of the IHE Technical Framework: Year 2. Transaction 13 is required for the Department System Scheduler/Order Filler and Image Manager Actors.

6.13.1   Scope

This transaction involves changes to procedure information communicated from Department System Scheduler to the Image Manager. Unlike the order ORM message sent between the Order Placer and Order Filler (where only the order status can be updated without requiring a Cancel/New Order to change an order), the ORM message from the Department System Scheduler/Order Filler and Image Manager can be a previously scheduled Requested Procedure identified by a Study Instance UID.

6.13.2   Use Case Roles
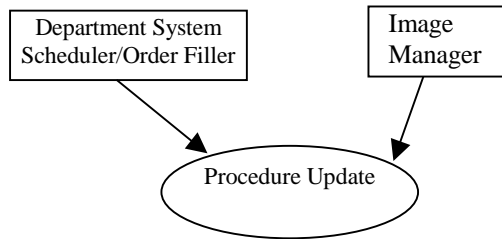
Actor: Department System Scheduler/Order Filler

Role: Responsible for scheduling placed orders and sending the timing, resource, procedure and other information to the Image Manager.

Actor: Image Manager

Role: May use the scheduling, resource, procedure, and other information to perform image management tasks such as autorouting or prefetching of images.

6.13.3   Referenced Standards

HL7 2.3.1 Chapters 2, 4

6.13.4   Interaction Diagram

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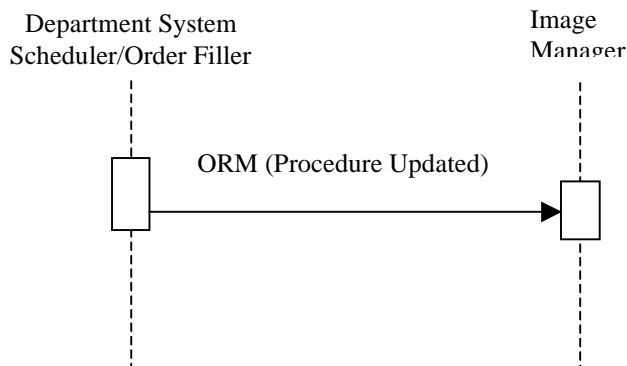
6.13.4.1   Trigger Events

A Procedure Update transaction is triggered in the case when the Department System Scheduler cancels, re-schedules or modifies characteristics of the procedure it previously scheduled and transmitted to the Image Manager via a Procedure Scheduled transaction (Transaction 4).

6.13.4.2   Message Semantics

The Procedure Update transaction is conveyed by the HL7 ORM message formatted according to the rules described in section 6.4. MSH-9 shall contain the value "ORM".

The following Order Control Codes are applicable for use in the field *ORC-1*.

Table 6.13-1. IHE Profile - Required Order Control Codes

Value	Description	Originator
CA	Cancel order request	DSS
XO	Change order request	DSS
DC	Discontinue order request	DSS

Adapted from the HL7 Standard, version 2.3.1

Only procedural information that is conveyed in the OBR and ORC segments of the message may be changed. Any updates of patient or visit information shall be performed by Transaction 12, Patient Update (see sections 6.1 and 6.12 for PID and PV1 information and updates).

The ORC and OBR elements given in table 6.13-2 shall not be altered after the initial Procedure Scheduled (section 6.4), regardless of the type of control code.

Table 6.13-2. Procedure Update Elements that should not be changed

Element Name	Element Number(s)
Placer Order Number	OBR-2, ORC-2
Filler Order Number	OBR-3, ORC-3
Placer Group Number	ORC-4
Study Instance UID	ZDS-1

Any other elements in the OBR or ORC segments may be changed when the Order Control Code = XO.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations are given in section 2.3.

6.13.4.3   Expected Actions

The Image Manager is expected to perform the following actions on the value of the field *ORC-1 Order Control Code*:

CA – Procedure has been cancelled, usually due to the cancellation of the underlying order; the Image Manager shall inactivate corresponding procedure information using Study Instance UID

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as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information. If the Department System Scheduler/Order Filler has been notified that a Performed Procedure Step is in progress for a Requested Procedure, the order control code DC should be used.

XO – Procedure-related information (including scheduled date/time and/or resource) has been changed. The Image Manager shall modify corresponding procedure information using the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information.

DC – Order to which the particular procedure is related has been discontinued after at least one Performed Procedure Step for this procedure has started. The Image Manager shall consider all remaining SPS known for that procedure (if any) cancelled. The Image Manager shall use the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient information.

6.14　Query Images

This section corresponds to Transaction 14 for the IHE Technical Framework: Year 2. Transaction 14 is required for the Image Archive and Image Display actors.

6.14.1　Scope

The Image Display queries the Image Archive for study, series and image instances for retrieval.

6.14.2　Use Case Roles
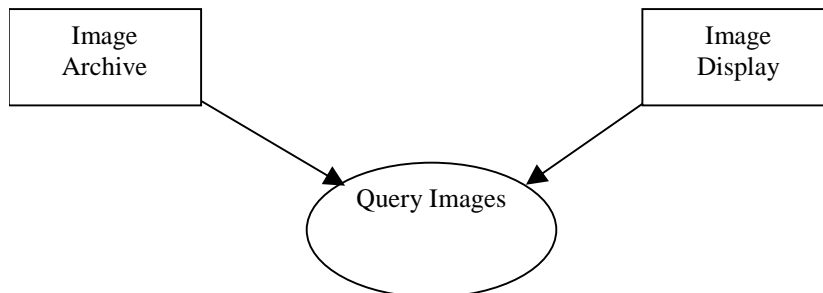
Actor: Image Archive

Role: Responds to queries for Studies, Series, Images.

Actor: Image Display

Role: Issues Queries for Studies, Series, Images

6.14.3　Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class

6.14.4   Interaction Diagram

Image Manager   Image
                                     Display
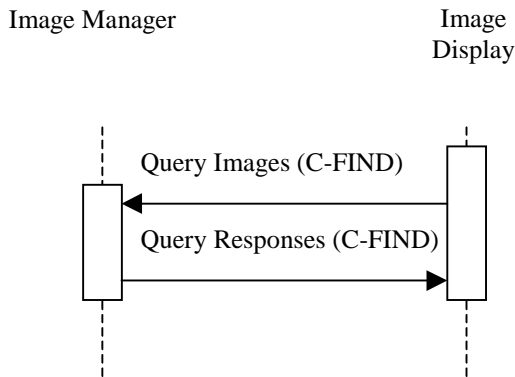
6.14.4.1   Query Images

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes will be supported. Refer to the DICOM Standard (DICOM 1999 PS 3.4) for detailed descriptive semantics.

6.14.4.1.1   Trigger Events

The user at the Image Display wishes to view selected images.

6.14.4.1.2   Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or optionally the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Image Display to the Image Archive. Hierarchical Search Method shall be supported.

The Image Display uses one or more matching keys as search criteria to obtain the list of matching entries in the Image Archive at the selected level (Patient & Study/Series/Image). Based on this list of entries, the Image Display may select relevant entries to be retrieved.

The matching keys and return keys to be supported by the Image Display (SCU) and the Image Manager (SCP) are defined in the table below. The table specifies for both the Query SCU (Image Display) and the Query SCP (Image Archive) if Matching Keys (keys used as matching criteria in the Query request) and Returned Keys (Keys used to request attributes to be returned in the query responses) are Required (R) or Optional (O). See section 2.2 for more information.

Table 6.14-1 below includes the definition of return and matching keys specified by DICOM. Requirements indicated with R+ highlight the requirements added by the IHE Technical Framework.

Table 6.14-1. Images Query Matching and Return Keys

Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Study Level						
Study Date	(0008,0020)	R+	R	R+	R	
Study Time	(0008,0030)	R+	R	R+	R	
Accession Number	(0008,0050)	R+	R	R+	R	
Patient Name	(0010,0010)	R+	R	R+	R	IHE-1, IHE-2
Patient ID	(0010,0020)	R+	R	R+	R	
Study ID	(0020,0010)	R+	R	R+	R	
Study Instance UID	(0020,000D)	R+	R	O	R	
Modalities in Study	(0008,0061)	R+	R+	R+	R+	
Referring Physician's Name	(0008,0090)	R+	R+	R+	R+	IHE-1,IHE-2
Study Description	(0008,1030)	O	O	O	O	
Procedure Code Sequence	(0008,1032)	O	O	O	O	
>Code Value	(0008,0100)	O	O	O	O	
>Coding Scheme Designator	(0008,0102)	O	O	O	O	
>Coding Scheme Version	(0008,0103)	O	O	O	O	
>Code Meaning	(0008,0104)	O	O	O	O	
Name of Physician(s) Reading Study	(0008,1060)	O	O	O	O	IHE-1, IHE-2
Admitting Diagnoses Description	(0008,1080)	O	O	O	O	
Referenced Study Sequence	(0008,1110)	O	O	O	O	
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Referenced Patient Sequence	(0008,1120)	O	O	O	O	
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Patient's Birth Date	(0010,0030)	O	O	R+	R+	
Patient's Birth Time	(0010,0032)	O	O	O	O	
Patient's Sex	(0010,0040)	O	O	R+	R+	

Other Patient IDs	(0010,1000)	O	O	O	O	
Other Patient Names	(0010,1001)	O	O	O	O	IHE-1, IHE-2
Patient's Age	(0010,1010)	O	O	O	O	
Patient's Size	(0010,1020)	O	O	O	O	
Patient's Weight	(0010,1030)	O	O	O	O	
Ethnic Group	(0010,2160)	O	O	O	O	
Occupation	(0010,2180)	O	O	O	O	
Additional Patient History	(0010,21B0)	O	O	O	O	
Patient Comments	(0010,4000)	O	O	O	O	
Other Study Numbers	(0020,1070)	O	O	O	O	
Number of Patient Related Studies	(0020,1200)	N/A	N/A	O	O	
Number of Patient Related Series	(0020,1202)	N/A	N/A	O	O	
Number of Patient Related Instances	(0020,1204)	N/A	N/A	O	O	
Number of Study Related Series	(0020,1206)	N/A	N/A	O	R+	
Number of Study Related Instances	(0020,1208)	N/A	N/A	O	R+	
Interpretation Author	(4008,010C)	O	O	O	O	IHE-1, IHE-2
Series Level						
Modality	(0008,0060)	R+	R	R+	R	
Series Number	(0020,0011)	R+	R	R+	R	
Series Instance UID	(0020,000E)	R+	R	O	R	
Number of Series Related Instances	(0020,1209)	N/A	N/A	O	*R*	
Performed Procedure Step ID	(0040, 0253)	O	O	O	O	
Reference Study Component Sequence	(0008,1111)	O	O	O	O	
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Request Attribute Sequence	(0040,0275)	R+^	R+^	R+^	R+^	IHE-3
>Requested Procedure ID	(0040,1001)	R+	R+	R+	R+	
>Scheduled Procedure Step ID	(0040,0009)	R+	R+	R+	R+	
Performed Procedure Step Start Date	(0040,0244)	R +	R+	R+	R+	

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Performed Procedure Step Start Time	(0040,0245)	R +	R+	R+	R+	
Composite Object Instance Level						
Instance Number	(0020,0013)	R	R	O	R	
Overlay Number	(0020,0022)	O	O	O	O	
Curve Number	(0020,0024)	O	O	O	O	
LUT Number	(0020,0026)	O	O	O	O	
SOP Instance UID	(0008,0018)	R+	R	O	R	
SOP Class UID	(0008,0016)	O	R	O	R+	IHE-4

Note: ^ = optional for IHE Technical Framework : Year 2 but required for Year 3.

The table below extends the table above with image-specific keys.

Table 6.14-2. Image Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Image Specific Level						
Rows	(0020 0010)	O	O	O	R+	
Columns	(0020,0011)	O	O	O	R+	
Bits Allocated	(0028,0100)	O	O	O	R+	
Number of Frames	(0028,0008)	O	O	O	R+	

IHE-1: Case insensitive matching is allowed in the IHE Technical Framework: Year 2, for attributes of VR PN. A DICOM Change Proposal (CP 190) to allow case insensitivity on PN attributes is currently pending.

IHE-2: SCUs are recommended to append wildcard "*" at the end of each component of any structured name to facilitate matching (i.e., PN attributes).

IHE-3: Universal Matching (selecting return keys) against an Attribute of VR SQ should be requested by the Query SCU using a Zero Length Sequence Attribute. Query SCPs shall accept such Universal Match Requests. In addition, Query SCPs are required by the DICOM Standard to support requests for a Universal Match for an SQ attribute encoded as a zero length item.

IHE-4: A SOP Class UID is a non-ambiguous key to identify a specific type of image (Modality is not).

6.14.4.1.3 Expected Actions

The Image Archive receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses. It is the responsibility of the Image Manager to assure that the patient and procedure information is current in the images when they are retrieved from the Image Archive. The patient and procedure information is updated through Transactions 12 and 13.
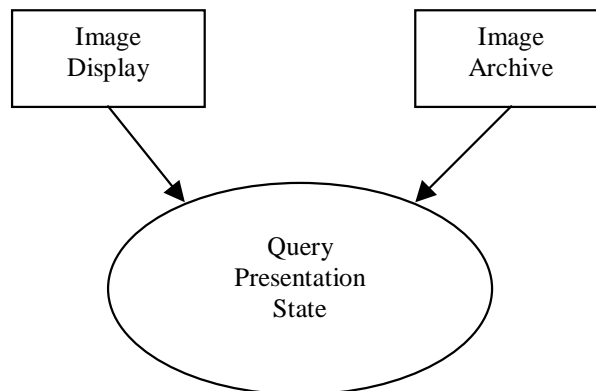

6.15 Query Presentation State

This section corresponds to Transaction 15 of the IHE Technical Framework: Year 2. Transaction 15 is required for the Image Archive Actor and is optional for the Image Display Actor.

6.15.1 Scope

This section describes the sequence of messages required for the Image Display to query the Image Archive for instances of Grayscale Softcopy Presentation States. The Image Display will query and then retrieve Presentation State objects together with the image data referenced in the return keys supplied in the response from the Image Archive. The transformations will be applied by the Image Display to the image data to assure the image display is consistent with the device that originally created and stored the Presentation State. The Image Display will be required to support all transformations defined in DICOM Supplement 33: Grayscale Softcopy Presentation State Storage. In addition, multiple Presentation States may exist that reference the same image data.

6.15.2 Use Case Roles

```
┌──────────┐              ┌──────────┐
│  Image   │              │  Image   │
│ Display  │              │ Archive  │
└──────────┘              └──────────┘
        ╲                      ╱
         ╲                    ╱
          ╲                  ╱
         ╭──────────────────────╮
        │        Query           │
        │      Presentation      │
        │        State           │
         ╰──────────────────────╯
```

Actor: Image Display

Role: Query for Grayscale Softcopy Presentation State objects together with the referenced image data and apply the transformations specified by the Presentation State. This actor must support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM 1999 PS 3.14. This device will implement the Query/Retrieve SOP Classes in the role of SCU.

Actor: Image Archive

Role: Respond to queries from the Image Display for Grayscale Softcopy Presentation States objects. This device will implement the Query/Retrieve SOP Classes in the role of SCP.

6.15.3   Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class

DICOM 1999 PS 3.14: Grayscale Standard Display Function

DICOM Supplement 33: Grayscale Softcopy Presentation State Storage

6.15.4   Interaction Diagram
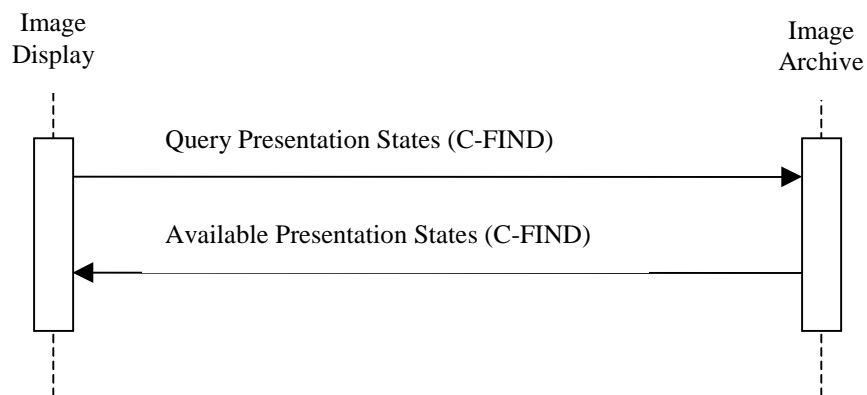
6.15.4.1   Query for Grayscale Softcopy Presentation States

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes will be supported. Refer to DICOM 1999 PS 3.4: Query/Retrieve Service Class for detailed descriptive semantics.

6.15.4.1.1   Trigger Events

The user of the Image Display wishes to query instances of Grayscale Softcopy Presentation States.

6.15.4.1.2   Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes. A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the optional DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class. The C-FIND request shall be sent from the Image Display to the Image Archive.

The matching keys and return keys to be supported by the Image Display (SCU) and the Image Archive (SCP) at the Study and Series level are defined in table 6.14-1.

Table 6.15-1 below specifies for both the Query SCU (Image Display) and the Query SCP (Image Archive) additional Matching Keys (keys used as matching criteria in the Query request) and Return Keys (keys used to request attributes to be returned in the query responses) that are Required ("R") or Optional ("O") specific (or pertaining) to Presentation State. See section 2.2

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for more information.

Table 6.15-1. Presentation State Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Presentation Label	(0070,0080)	O	O	R+	R+
Presentation Description	(0070,0081)	O	O	O	R+
Presentation Creation Date	(0070,0082)	O	O	R+	R+
Presentation Creation Time	(0070,0083)	O	O	R+	R+
Presentation Creator's Name	(0070,0084)	O	O	R+	R+
Referenced Series Sequence	(0008,1115)	O	O	R+	R+
>Series Instance UID	(0020,000E)	O	O	O	R+
>Referenced Image Sequence	(0008,1140)	O	O	O	R+
>>Referenced SOP Class UID	(0008,1150)	O	O	O	R+
>>Referenced SOP Instance UID	(0008,1155)	O	O	O	R+

6.15.4.1.3   Expected Actions

The Image Archive receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses. It is the responsibility of the Image Manager to assure that the patient and procedure information is current in the images and Softcopy Presentation State objects when they are retrieved from the Image Archive. The patient and procedure information is updated through transactions 12 and 13.

6.16   Retrieve Images

This section corresponds to Transaction 16 of the IHE Technical Framework: Year 2. Transaction 16 is required for the Image Archive and Image Display actors.

6.16.1   Scope

After the Image Display request for retrieval, the requested DICOM Images are transferred from the Image Archive to the Image Display for viewing.

6.16.2   Use Case Roles

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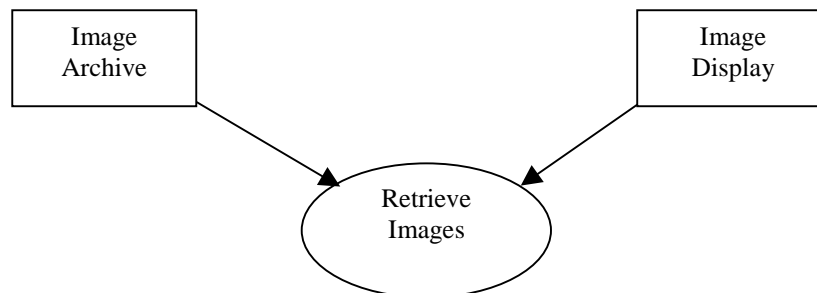
Actor: Image Archive:

Role: Sends requested images to the Image Display Actor.

Actor: Image Display

Role: Receives requested images from the Image Archive Actor.

6.16.3   Referenced Standards

DICOM 1999 PS 3.4: Storage Service Class

DICOM 1999 PS 3.4: Query/Retrieve Service Class

6.16.4   Interaction Diagram

Image Manager   Image
                                                   Display

Retrieve Images (C-MOVE)

Store Images (C-STORE)

View Images
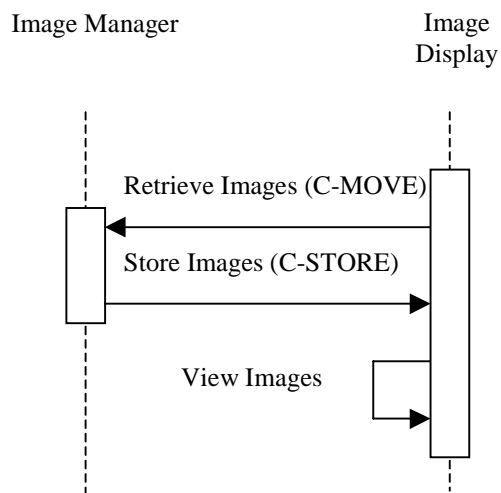
6.16.4.1   Retrieve Images

The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes will be supported. The DICOM Image Storage SOP Classes will be supported by the Image Archive as an SCP. Refer to DICOM 1999 (Part PS 3.4, Annex C, for detailed descriptive semantics.

6.16.4.1.1   Trigger Events

Images are selected for viewing at the Image Display.

6.16.4.1.2   Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Image Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class or the DICOM Patient Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the Image Display to the Image Archive.

6.16.4.1.3   Expected Actions

The Image Archive receives the C-MOVE request, establishes a DICOM association with the Image Display and uses the appropriate DICOM Image Storage SOP Classes to transfer the requested images. The Image Display is expected to support at least one of the SOP Classes specified in table 6.8-1. It is assumed that support of retrieval for a SOP Class also means support for display.

6.16.4.2   View Images

This transaction relates to the "View Images" event of the above interaction diagram.

6.16.4.2.1   Trigger Events

The Image Display is requested to display the images.

6.16.4.2.2   Invocation Semantics

This is a local invocation of functions at the Image Display, and the method used by the Image Display to interpret and display the image data in a meaningful way is outside the scope of the IHE Technical Framework. If the DICOM image is referenced by other DICOM composite objects, such as Grayscale Softcopy Presentation States, it is optional for the Image Display to actually retrieve and display/apply these objects.

6.16.4.2.3   Expected Actions

The Image Display presents to the user a DICOM Image.

6.17   Retrieve Presentation States

This section corresponds to Transaction 17 of the IHE Technical Framework: Year 2. Transaction 17 is required for the Image Archive Actor and optional for the Image Display Actor.

6.17.1   Scope

This section describes the sequence of messages required for the Image Display to retrieve Grayscale Softcopy Presentation State Instances from the Image Archive. The Image Display will query and then retrieve Presentation State objects together with the image data referenced in the return keys supplied in the response from the Image Archive. The transformations will be applied by the Image Display to the image data to assure the image display is consistent with the device that originally created and stored the Presentation State. The Image Display will be required to support all transformations defined in DICOM Supplement 33: Grayscale Softcopy Presentation State Storage. In addition, multiple Presentation States may exist that reference the same image data.

6.17.2   Use Case Roles
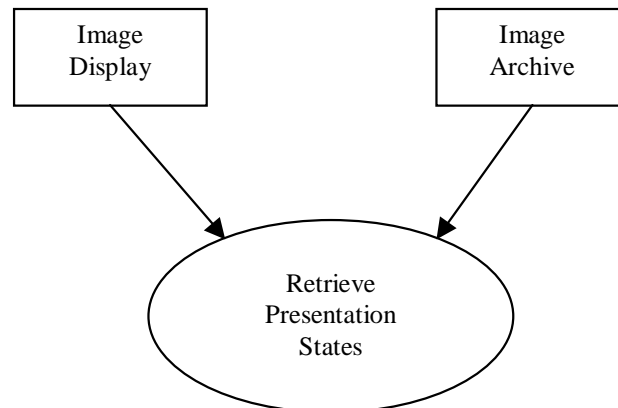
Actor: Image Display

Role: Retrieve Grayscale Softcopy Presentation State objects together with the referenced image data and apply the transformations specified by the Presentation State. This actor must support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM 1999 PS 3.14. This device will implement the Query/Retrieve SOP Classes in the role of an SCU.

Actor: Image Archive

Role: Respond to retrieve requests from the Image Display for Grayscale Softcopy Presentation States objects. Transmit requested Grayscale Softcopy Presentation State object(s) to the Image Display. This device will implement the Query/Retrieve SOP Classes in the role of an SCP.

6.17.3   Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class

DICOM 1999 PS 3.14: Grayscale Standard Display Function

DICOM Supplement 33: Grayscale Softcopy Presentation State Storage

6.17.4   Interaction Diagram
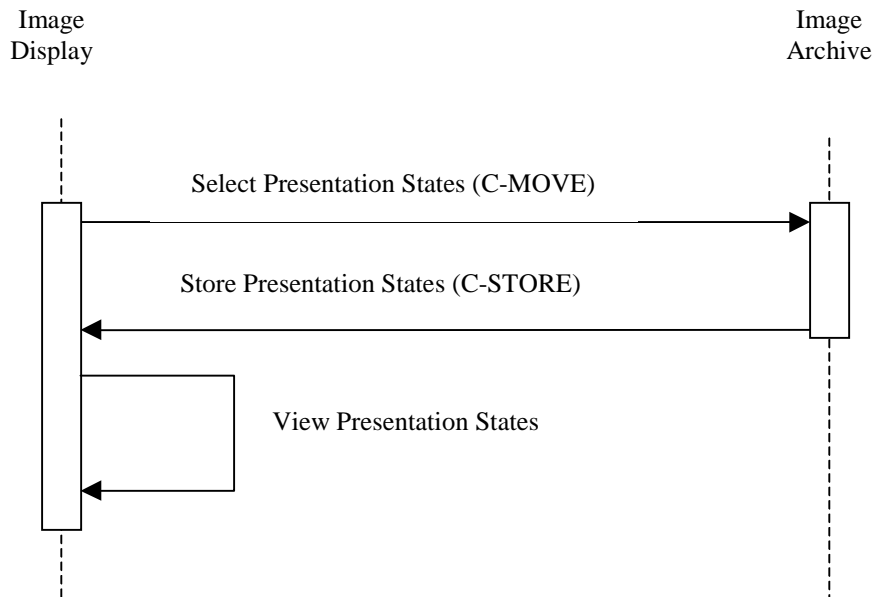
6.17.4.1   Retrieve Grayscale Softcopy Presentation State

This transaction refers to the "C-MOVE" and "C-STORE" messages between the Image Display and Image Archive in the above interaction diagram. The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes will be supported. Refer to the DICOM Standard (DICOM 1999 PS 3.4) for detailed descriptive semantics.

6.17.4.1.1   Trigger Events

The Image Display selects specific Grayscale Softcopy Presentation State objects to retrieve from the Image Archive.

6.17.4.1.2   Message Semantics

The message semantics are defined in the DICOM Query/Retrieve Service Class section of the DICOM 1999 PS 3.4: Query/Retrieve Service Class. It is the responsibility of the Image Manager to assure that the patient and procedure information is current in the images and Softcopy Presentation State objects when they are retrieved from the Image Archive.

6.17.4.1.3   Expected Actions

The Image Archive receives the C-MOVE request, establishes a DICOM association with the Image Display, and uses the DICOM Grayscale Softcopy Presentation State Storage SOP Class to transfer the requested Presentation State objects.

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6.17.4.2   View Presentation States

This transaction relates to the "View Presentation States" event in the above interaction diagram. Presentation States cannot be viewed by themselves but must be applied to an image. Refer to section 6.16 for a description of the transaction used to retrieve images to which Presentation States may be applied.

6.17.4.2.1   Trigger Events

The Image Display receives Presentation State instances from the Image Archive

6.17.4.2.2   Invocation Semantics

This is a local invocation of functions resident within the Image Display. The method used by the Image Display to present images for viewing by the user after the Presentation State transformations have been applied is outside the scope of the IHE Technical Framework.

6.17.4.2.3   Expected Actions

The Image Display applies the transferred Grayscale Softcopy Presentation State to image data and renders it for viewing.

6.18   Creator Images Stored

This section corresponds to Transaction 18 of the IHE Technical Framework: Year 2. Transaction 18 is required for the Image Archive Actor and optional for the Image Creator Actor. However, the Image Creator Actor is required to support either Transaction 18 or Transaction 19, and may support both.

6.18.1   Scope

In the Creator Images Stored transaction, the Image Creator sends the newly generated images for a study to the Image Archive.

6.18.2   Use Case Roles
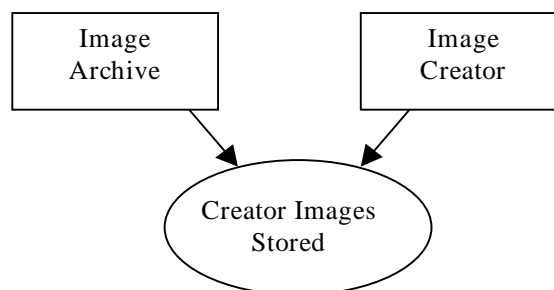
Actor: Image Creator

Role: Transmit generated image data to Image Archive.

Actor: Image Archive

Role: Accept and store images from Image Creators.

6.18.3   Referenced Standards

DICOM 1999 PS 3.4: Storage Service Class.

6.18.4   Interaction Diagram

```
   Image                                              Image
   Creator                                            Archive

         ┌─┐              C-STORE (Images Stored)           ┌─┐
         │ │ ──────────────────────────────────────────────▶│ │
         └─┘                                                 └─┘
```

6.18.4.1   Images Stored

6.18.4.1.1   Trigger Events

The Image Creator can transfer images to the Image Archive sequentially within one or more DICOM associations, as the images become available or collectively.

6.18.4.1.2   Message Semantics

The Image Creator uses the DICOM C-STORE message to transfer the images. The Image Creator is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

Per the DICOM Standard the Image Creator shall create a new series for its created images and not extend series containing source images.

The Image Creator derives images from source images, and the derived images may or may not have the same Image SOP Class as the source images.

The source images may include Performed Procedure Step relationship information. This information will include Scheduled Procedure Step information for the procedure performed at an Acquisition Modality. When present in the source images, the Image Creator shall extract

---

appropriate Scheduled Procedure Step information and include it with PPS information produced by the Image Creator.

See appendix C for rules on how to use the source image information in the derived image objects.

6.18.4.1.3   Expected Actions

The Image Archive will store the received DICOM objects.

6.19   Creator Presentation State Stored

This section corresponds to Transaction 19 of the IHE Technical Framework: Year 2. Transaction 19 is required for the Image Archive Actor and optional for the Image Creator Actor. However, the Image Creator Actor is required to support either Transaction 18 or Transaction 19, and may support both.

6.19.1   Scope

This section describes DICOM Grayscale Softcopy Presentation States Storage requests issued by the Image Creator to the Image Archive. The Image Creator sends Presentation States for storage along with the images so they could be later used for support of consistent display of imaging data. The Image Creator will be the DICOM Store SCU and the Image Archive will be the DICOM Store SCP.   DICOM Supplement 33: Grayscale Softcopy Presentation State Storage defines the transformations supported by this transaction.

6.19.2   Use Case Roles
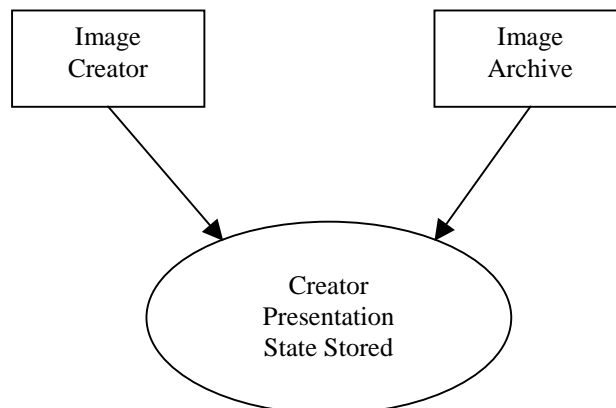
Actor: Image Creator

Role: Generate image data and Grayscale Softcopy Presentation State objects for storage to the Image Archive. This actor must support pixel rendering according to the Grayscale Standard Display Function as defined in DICOM 1999 PS 3.14.

Actor: Image Archive

Role: Accept and store Grayscale Softcopy Presentation State Instances received from the Image Creator. This transaction describes the role related only to storage of the Presentation State information.

6.19.3   Referenced Standards

DICOM 1999 PS 3.4: Storage Service Class

DICOM Supplement 33: Grayscale Softcopy Presentation State Storage

DICOM 1999 PS 3.14: Grayscale Standard Display Function

6.19.4   Interaction Diagram

```
    Image                                    Image
    Creator                                  Archive

            ┌──┐                              ┌──┐
            │  │   C-STORE (Presentation State Stored)   │  │
            │  │ ──────────────────────────────────────▶ │  │
            └──┘                              └──┘
```

6.19.4.1   Creator Presentation State Stored

6.19.4.1.1   Trigger Events

The Image Creator generates a Grayscale Softcopy Presentation State Instance and sends it to the Image Archive for storage.

6.19.4.1.2   Message Semantics

The Image Creator uses the DICOM C-STORE message to store Grayscale Softcopy Presentation States. Message semantics are defined in the Grayscale Softcopy Presentation State Storage SOP Class behavior section of the DICOM Standard (DICOM Supplement 33).

The Image Creator derives images from source images that may include Modality Performed Procedure Step relationship information. This information will include Scheduled Procedure Step information for the procedure performed at an Acquisition Modality. When present in the source images, the Image Creator shall extract appropriate Scheduled Procedure Step information and include it with PPS information produced by the Image Creator.

6.19.4.1.3   Expected Actions

The Image Archive will store the received Grayscale Softcopy Presentation State objects.

6.20   Creator Procedure Step In Progress

This section corresponds to Transaction 20 of the IHE Technical Framework: Year 2. Transaction 20 is required for the Department System Scheduler/Order Filler, Image Manager and Performed Procedure Step Manager actors. It is optional for the Image Creator actor.

6.20.1   Scope

This Performed Procedure Step of the Image Creator will be appended to the Modality Performed Procedure Steps done at the Acquisition Modality for the same Scheduled Procedure Step. It includes a message from the Image Creator to the Performed Procedure Step Manager, which in turn issues the messages to the Department System Scheduler/Order Filler and the Image Manager. The Performed Procedure Step Manager must support forwarding messages to two different destinations. It shall start issuing messages to the configured destinations immediately after it accepts the corresponding messages from the Image Creator.

For the details on the Performed Procedure Step Manager refer to section 6.6.1.

6.20.2   Use Case Roles
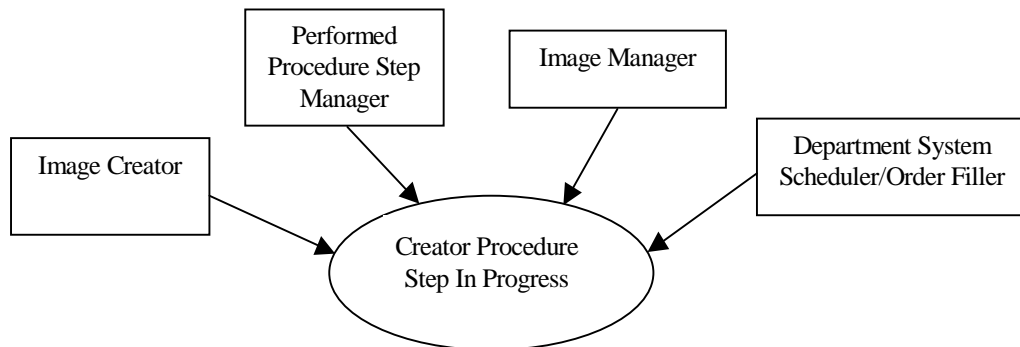
Actor: Department System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager.

Actor: Image Creator.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step has started.

Actor: Performed Procedure Step Manager.

Role: Accepts Performed Procedure Step information from an Image Creator and transmits it to the Department System Scheduler/Order Filler and Image manager.

6.20.3   Referenced Standards

DICOM 1999 PS 3.4: Modality Performed Procedure Step SOP Class.

6.20.4   Interaction Diagram
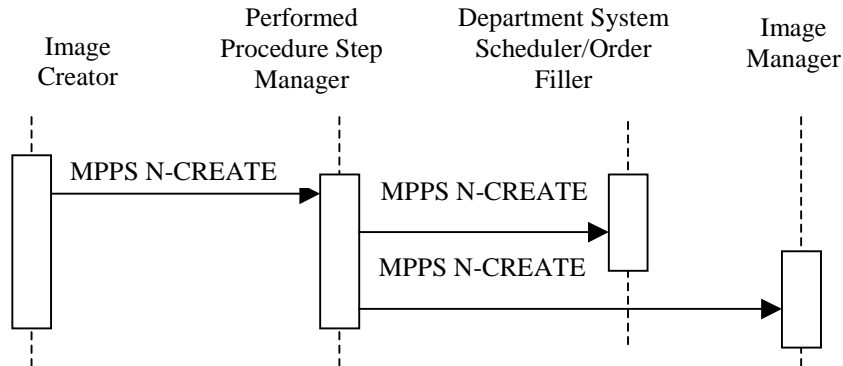
6.20.4.1   Procedure Step Started Message

6.20.4.1.1   Trigger Event

Technologist begins with the generation of images at the Image Creator station.

6.20.4.1.2   Message Semantics

The Image Creator uses the Modality Performed Procedure Step SOP Class (N-CREATE Service) to inform the Performed Procedure Step Manager that a specific image generation Procedure Step has been started and is in progress. In turn, the Performed Procedure Step Manager uses the N-CREATE Service to forward the information to the Department System Scheduler/Order Filler and Image Manager. The Performed Procedure Step Manager shall use the same Performed Procedure Step SOP Instance UID during this interchange. The following aspects shall be taken into the account during implementation of this step.

6.20.4.1.2.1   Patient/Procedure/Procedure Step Information

The Image Creator shall ensure that the Patient/Procedure/Procedure Step information it has is valid and current. In this case the identification and relationship information will not be provided by a Modality Worklist, but the Image Creator extracts the Scheduled Procedure Step information from the images it uses as originals. If those images satisfied several Scheduled Procedure Steps, information about all of them may be recorded in the resulting PPS messages and image headers.

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6.20.4.1.2.2   Required Attributes

Appendix C lists a number of attributes that have to be properly handled by the Image Creator to ensure consistency between Performed Procedure Step object attributes and information included into the generated images.

6.20.4.1.2.3   Relationship between Scheduled and Performed Procedure Steps

In this case the Scheduled Procedure Step is specified in the relationship part of the MPPS information in the source images. Therefore we have the Append Case relationship between Scheduled and Performed Steps. Refer to appendix C for details of forming attributes (Study Instance UID, Procedure ID, Accession Number, etc.) in this case.

6.20.4.1.2.3.1   Append Case
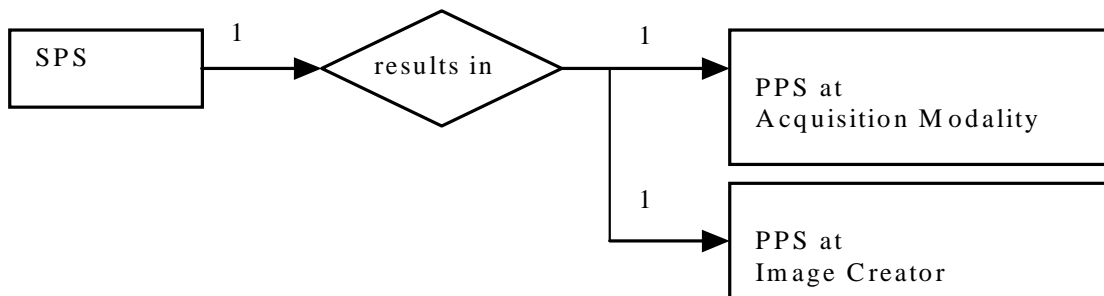
This is a special case of 1-to-N relationship between SPS and PPS where first the PPS is generated at the Acquisition Modality in response to an SPS. The new Performed Procedure Steps is added at the Image Creator at a later time. The Performed Procedure Steps will refer back to the same Requested Procedure and to the original SPS. All Requested Procedure and Scheduled Procedure Step attributes contained in the source images shall be copied to the Performed Procedure Step Relationship Module (see appendix C).

6.20.4.1.3   Expected Actions

The DSS/Order filler receives information from the Performed Procedure Step Manager and links it with the Requested Procedure. If the Requested Procedure ID is transmitted empty, the Department System Scheduler/Order Filler and the Image Manager will create an exception that must be manually resolved to link the Performed Procedure Step to the appropriate procedure.

6.21   Creator Procedure Step Completed

This section corresponds to Transaction 21 of the IHE Technical Framework: Year 2. Transaction 21 is required for the Department System Scheduler/Order Filler, Image Manager and Performed Procedure Step Manager actors. It is optional for the Image Creator actor.

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6.21.1   Scope

This transaction includes a message from the Image Creator to the Performed Procedure Step Manager, which in turn issues the messages to the DSS/Order Filler and the Image Manager that the Performed Procedure Step has been completed. Information is not being released for billing at this point but a code may be assigned. The Image Manager may need the information to co-locate images of the same study. The Performed Procedure Step Completed message does not necessarily mean that the set of images is complete or available for retrieval.

6.21.2   Use Case Roles
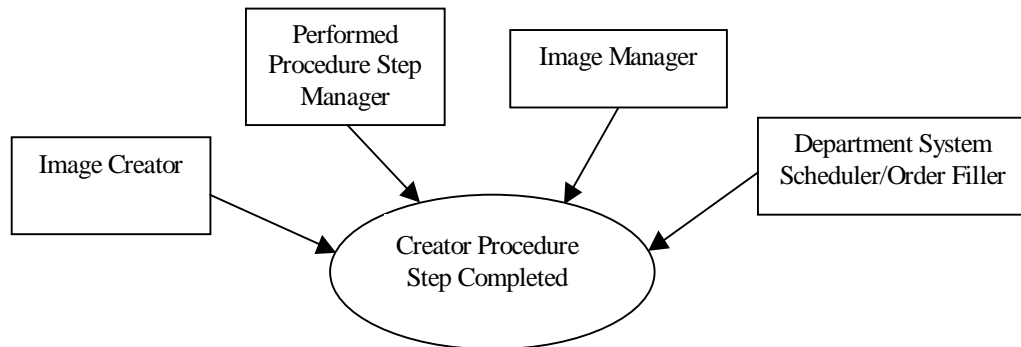
Actor: Departmental System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager.

Actor: Image Creator.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step is completed.

Actor: Performed Procedure Step Manager.

Role: Accepts Performed Procedure Step information from an Image Creator and transmits it to the Department System Scheduler/Order Filler and the Image Manager.

6.21.3   Referenced Standards

DICOM 1999 PS 3.4: Modality Performed Procedure Step SOP Class.

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6.21.4   Interaction Diagram
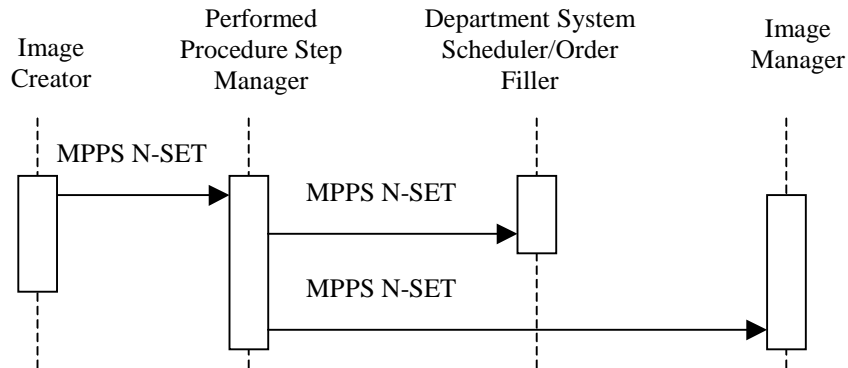
Note: The diagram above shows the sequencing of messages for the Performed Procedure Step SOP Class. Image Creators will also implement the Storage and Storage Commitment classes. The timing relationship between MPPS messages and Storage and Storage Commitment messages is not specified. That is, MPPS messages may occur before or after storage requests.

6.21.4.1   Procedure Step Completed/Discontinued

6.21.4.1.1   Trigger Event

Technologist completes the procedure step from the Image Creator station.

6.21.4.1.2   Message Semantics

The Image Creator uses the Modality Performed Procedure Step SOP Class (N-SET Service) to inform the Performed Procedure Step Manager that a specific Procedure Step has been completed or discontinued. For further details on the message semantics refer to section 6.7.4.1.2.

The Image Creator derives images from source images that include Performed Procedure Step information. This information will include scheduled step information for the procedure performed at an Acquisition Modality. When present in the source images, the Image Creator shall extract appropriate PPS information and include it with the PPS messages and the images produced by the Image Creator.

6.21.4.1.3   Expected Actions

The Image Manager and Department System Scheduler/Order Filler receive information about the Procedure Step being completed or discontinued. The Image Manager and Department System Scheduler/Order Filler are not required to act on intermediate N-SET messages with the PPS Status "IN PROGRESS".

6.22   Creator Storage Commitment

This section corresponds to Transaction 22 of the IHE Technical Framework: Year 2. Transaction 22 is required for the Image Manager and Image Creator actors.

6.22.1   Scope

In the Creator Images Stored and/or the Creator Presentation States Stored transaction the Image Creator has sent the generated images and/or Presentation States of a study to the Image Archive. In this Creator Storage Commitment transaction the Image Creator requests that the Image Manager/Image Archive accept responsibility for the images and/or Presentation States. The objective of this transaction is to provide a formal release of storage responsibility by the Image Creator, allowing it to reuse its internal resources allocated to the study.

6.22.2   Use Case Roles
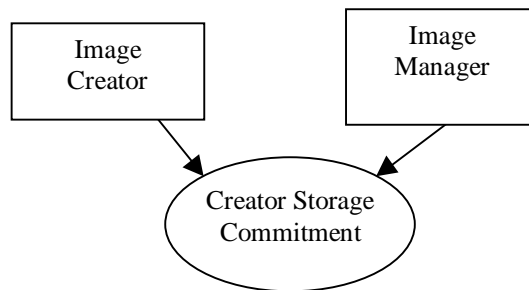
Actor: Image Creator

Role: Make requests for storage commitment to the Image Manager for the images and/or Presentation States previously transmitted.

Actor: Image Manager.

Role: Assume responsibility for reliable storage, retrieval, and validity of image data and Presentation States.

6.22.3   Referenced Standards

DICOM 1999 PS 3.4: Storage Commitment Push Model SOP Class.

6.22.4   Interaction Diagram

Image
Creator

Image
Manager

Storage Commitment
N-ACTION

Storage Commitment
N-EVENT-REPORT
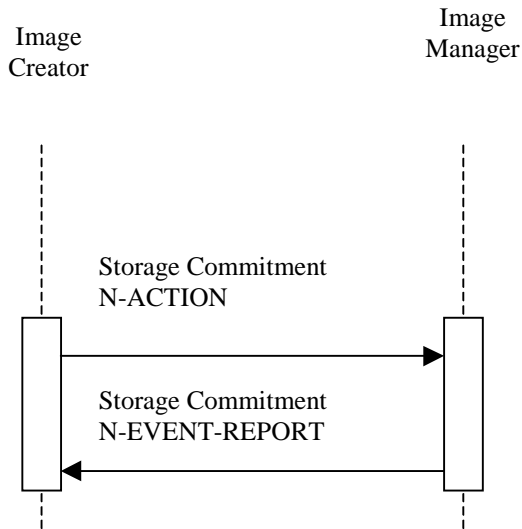
6.22.4.1   Images Committed

The Storage Commitment Push Model SOP Class shall be used as reflected in the interaction diagram. The Storage Commitment Pull Model SOP Class will not be supported. Refer to the DICOM 1999 PS 3.4 for detailed descriptive semantics.

6.22.4.1.1   Trigger Events

The Image Creator is the Storage Commitment SCU and can issue a commitment request at any time after the successful transfer of one or more SOP Instances to the Image Manager, which is the Storage Commitment SCP.

6.22.4.1.2   Message Semantics

Refer to Section 6.10.4.1.2 for the semantics of this message (with Image Creator in place of Acquisition Modality).

6.22.4.1.3   Expected Actions

The Image Manager in coordination with the Image Archive accepts responsibility for the safe storage of the transferred image data and/or Presentation States. (The form of the cooperation is beyond the scope of IHE Technical Framework.) Ownership of data transfers from the Image Creator to the Image Manager. The Image Creator is then free to manage its own internal resources accordingly.

6.23 Print Request with Presentation LUT

This section corresponds to Transaction 23 of the IHE Technical Framework: Year 2. Transaction 23 is required for the Print Composer and Print Server actors.

6.23.1 Scope

This transaction supports the capability of the Print Composer to ensure display consistency for images rendered by the Print Server. The Print Composer sends a DICOM Print Request to the Print Server. The request includes the specification of a Presentation Look Up Table (LUT) to be applied to the image data at the Film Box level. The Print Composer will be the DICOM Print SCU and the Print Server will be the DICOM Print SCP.

6.23.2 Use Case Roles
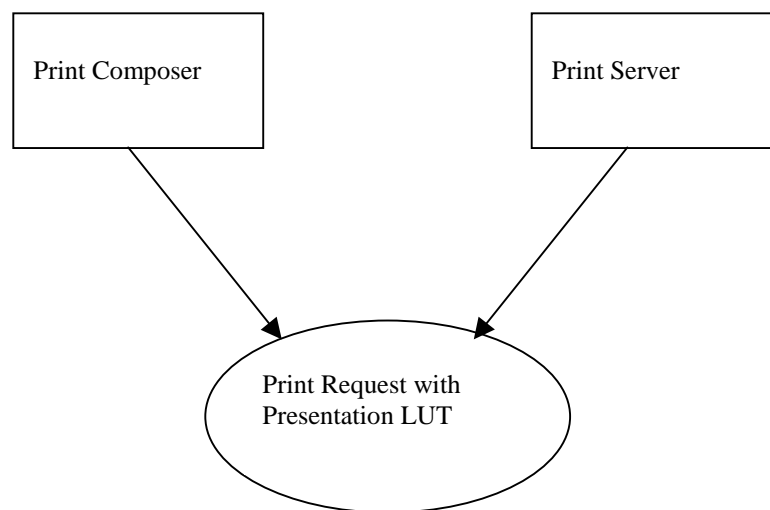
Actor: Print Composer

Role: Generate DICOM Print Requests as a DICOM Print SCU. The system must support pixel rendering according to the DICOM Grayscale Standard Display Function (GSDF) as defined in DICOM 1999 PS 3.14. The Print Requests must specify and reference Presentation LUTs to be applied by the SCP to the image data to maintain desired image perception.

Actor: Print Server

Role: Process DICOM Print Requests as a DICOM Print SCP. The system must support pixel rendering according to the DICOM Grayscale Standard Display Function (GSDF) as defined in DICOM 1999 PS 3.14 and be able to transform the image data using the specified Presentation LUT to produce the desired image perception.

6.23.3 Referenced Standards

DICOM 1999 PS 3.4: Print Management Service Class

DICOM 1999 PS 3.4: Presentation LUT SOP Class

DICOM 1999 PS 3.14: Grayscale Standard Display Function

6.23.4 Interaction Diagram

```
       Print                                              Print
      Composer                                            Server
         ┊                                                  ┊
        ┌─┐      DICOM Film Session N-CREATE              ┌──┐
        │ │ ─────────────────────────────────────────────▶│  │
        └─┘                                               │  │
        ┌─┐      DICOM Presentation LUT N-CREATE          │  │
        │ │ ─────────────────────────────────────────────▶│  │
        └─┘                                               │  │
        ┌─┐      DICOM Film Box N-CREATE                  │  │
        │ │ ─────────────────────────────────────────────▶│  │
        │ │                                               │  │
        │ │      DICOM Image Box N-SET                    │  │
        │ │ ─────────────────────────────────────────────▶│  │
        └─┘                                               │  │
        ┌─┐      DICOM Film Box N-ACTION                  │  │
        │ │ ─────────────────────────────────────────────▶│  │
        └─┘                                               │  │
        ┌─┐      DICOM Film Session N-ACTION              │  │
        │ │ ─────────────────────────────────────────────▶│  │
        └─┘                                               └──┘
        ┌─┐      Print Status (N-EVENT-REPORT)            ┌──┐
        │ │ ◀─────────────────────────────────────────────│  │
        └─┘                                               └──┘
         ┊                                                  ┊
```

Note: The diagram above shows the
sequencing of messages for printing
requests. Timing of the Print Status N-
EVENT-REPORT message is not specified.
It may occur at any time when Print Server
needs to report its status to Print Composer

6.23.4.1 DICOM Film Session N-CREATE

Support of this message is required for the Print Composer and Print Server in the IHE Technical
Framework: Year 2. The Film Session N-CREATE message describes the presentation
parameters common to all sheets of film in a film session. Implementation of this message will
be according to the DICOM Basic Print Management Meta SOP Class.

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6.23.4.1.1 Trigger Events

The Print Composer initiates a Print Request to the Print Server.

6.23.4.1.2 Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Basic Film Session SOP Class.

6.23.4.1.3 Expected Actions

The Print Server shall create the Film Session SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server shall return the status code of the requested SOP Instance creation as defined for the Basic Film Session SOP Class.

6.23.4.2 DICOM Presentation LUT N-CREATE

Support of this message is required by the Print Composer and Print Server in the IHE Technical Framework: Year 2. The Presentation LUT data specified by this N-CREATE will be used to transform the image data at the film box level to realize specific image display characteristics suitable to the Print Composer. In addition, this message can use the Presentation LUT Shape Attribute to specify a pre-defined Presentation LUT Shape (The Presentation LUT Shape value of "LIN OD" will not be supported for the IHE Technical Framework: Year 2). Presentation LUT information will only be specified and applied at the Film Box level for the IHE Technical Framework: Year 2.

6.23.4.2.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Film Session N-CREATE message.

6.23.4.2.2 Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Presentation LUT SOP Class. Presentation LUTs supplied by the Print Composer will be required to have a number of entries corresponding to the bit depth of the image data (e.g. 256 entries for 8 bit image data, 4096 entries for 12 bit image data).

6.23.4.2.3 Expected Actions

The Print Server shall create a Presentation LUT SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server shall return the status code of the requested SOP Instance creation as defined for the Presentation LUT SOP Class.

6.23.4.3   DICOM Film Box N-CREATE

Support of this message is required by the Print Composer and Print Server in the IHE Technical Framework: Year 2. The Film Box N-CREATE message describes the presentation parameters common to a single sheet of film in a film session.

6.23.4.3.1   Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Presentation LUT N-CREATE message.

6.23.4.3.2   Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Basic Film Box SOP Class. A Film Box N-CREATE will be issued for each sheet of film in a multi-film session. The Print Composer, behaving as a DICOM Print SCU, may use default values for Illumination(2010,015E), Reflective Ambient Light (2010,0160), Min Density(2010,0120), and Max Density(2010,0130) as specified in DICOM 1999 PS 3.14. In addition, the Film Box N-CREATE message will reference Presentation LUT SOP instances created by the Presentation LUT N-CREATE message. Table 6.23-1 below specifies the Basic Film Box Attribute values required to be supported by the SCU.

Table 6.23-1. Film Box Module Attributes Supported by the Print Composer

Tag	Attribute Name	Supported Values
(2010,0010)	Image Display Format	STANDARD\C,R (C = columns, R = rows)
(2010,0040)	Film Orientation	PORTRAIT LANDSCAPE
(2010,0050)	Film Size ID	8INX10IN 11INX14IN 14INX17IN
(2010,0060)	Magnification Type	REPLICATE BILINEAR CUBIC NONE

6.23.4.3.3   Expected Actions

The Print Server shall create the Film Box SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server will create an Image Box SOP Instance for each image box defined by the Image Display Format attribute (2010,0010) at the time the Basic Film Box SOP Instance is created. The Print Server shall return the status code of the requested SOP Instance

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creation as defined for the Basic Film Box SOP Class. Additional behavior is defined in the description of the Basic Film Box SOP Class for the DICOM Print Management Service Class within the DICOM Standard.

6.23.4.4   DICOM Image Box N-SET

Support of this message is required by Print Composer and Print Server in the IHE Technical Framework: Year 2. The Image Box N-SET message describes the presentation parameters and image pixel data specific to a single image box on a single sheet of film within a film session.

6.23.4.4.1   Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Film Box N-CREATE message.

6.23.4.4.2   Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Image Box SOP Classes. An Image Box N-SET will be issued for each Image Box defined by the Display Format attribute (2010,0010) of the Film Box N-CREATE message. The Image Box N-SET message shall reference Presentation LUT SOP instances created by the Presentation LUT N-CREATE message.

6.23.4.4.3   Expected Actions

The Print Server will apply the specified image box attributes to the Image Box SOP Instance. The Print Server shall return the status code of the requested SOP Instance update as defined for the Image Box SOP Class.

6.23.4.5   DICOM Film Box N-ACTION

Support of this message is required by the Print Composer and Print Server in the IHE Technical Framework: Year 2. The Film Box N-ACTION message is used to print a single sheet of film in the film session.

6.23.4.5.1   Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the last Image Box N-SET message for the specified Film Box.

6.23.4.5.2   Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Film Box SOP Classes.

6.23.4.5.3 Expected Actions

The sheet of film described by the film box is printed by the Print Server. Presentation LUT SOP Instances referenced at the Film Box or Image Box levels will be applied to the image data. The Print Server shall return the appropriate status code as defined for the Film Box N-ACTION DIMSE Service of the DICOM Print Management Service Class.

6.23.4.6 DICOM Film Session N-ACTION

Support of this message is optional by the Print Composer and Print Server in the IHE Technical Framework: Year 2. The Film Session N-ACTION message is used to print all sheets of film in the film session.

6.23.4.6.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the last Image Box N-SET message for the specified Film Session

6.23.4.6.2 Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Film Session SOP Classes.

6.23.4.6.3 Expected Actions

The film session is printed by the Print Server. Presentation LUT SOP Instances referenced at the Film Box or Image Box levels will be applied to the image data. The Print Server shall return the appropriate status code as defined for the Film Session N-ACTION Service of the DICOM Print Management Service Class.

6.23.4.7 Print Status (N-EVENT-REPORT)

Support of this message is required by the Print Composer and Print Server in the IHE Technical Framework: Year 2. The N-EVENT-REPORT is used to report Print Server status to the Print Composer in an asynchronous manner. That is, a print SCP may send an N-EVENT-REPORT message while the SCU is transmitting additional print commands. The SCU and SCP are required to accommodate these asynchronous messages.

6.23.4.7.1 Trigger Events

This message will be triggered when the Print Server senses a change in the status related to the Print Request that is worthy of notification to the Print Composer .

6.23.4.7.2 Message Semantics

The message semantics are defined by the DICOM Print Management Service Class Behavior for the Printer SOP Class.

6.23.4.7.3   Expected Actions

The Print Composer will return the confirmation of the N-EVENT-REPORT operation to the Print Server.

6.24   Report Submission

This section corresponds to Transaction 24 of the IHE Technical Framework: Year 2. Transaction 24 is required for the Report Creator and Report Manager actors.

6.24.1   Scope

In the Report Submission transaction, the Report Creator transmits a DICOM Structured Report (SR) object in an initial draft or final state to the Report Manager.

A final report is defined as one where the Completion Flag (0040,A491) attribute is set to "COMPLETE" and where the Verified Flag (0040,A493) attribute is set to "VERIFIED". Reports with any other values for the Completion Flag (0040,A491) or the Verified Flag (0040,A493) attributes are considered draft reports.

6.24.2   Use Case Roles
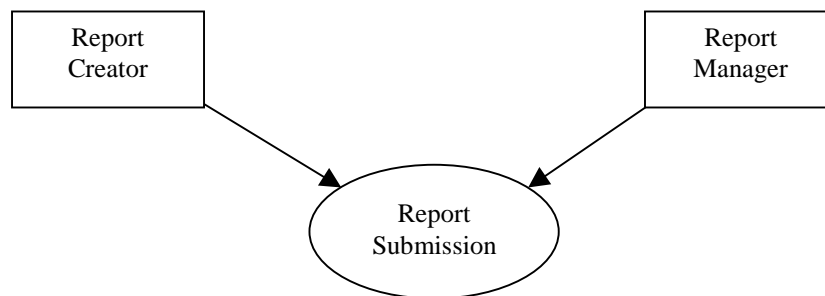
Actor: Report Creator

Role: Transmit draft or final DICOM Structured Reports to Report Manager.

Actor: Report Manager

Role: Accept draft and final DICOM Structured Reports for management.

6.24.3   Referenced Standards

DICOM Supplement 23: Structured Reporting Storage SOP Classes (Final Text)

6.24.4   Interaction Diagram

6.24.4.1   Report Creation

This transaction relates to the "Report Creation" event in the above interaction diagram.

6.24.4.1.1   Trigger Events

The user at the Report Creator wishes to create a DICOM Structured Report.

6.24.4.1.2   Invocation Semantics

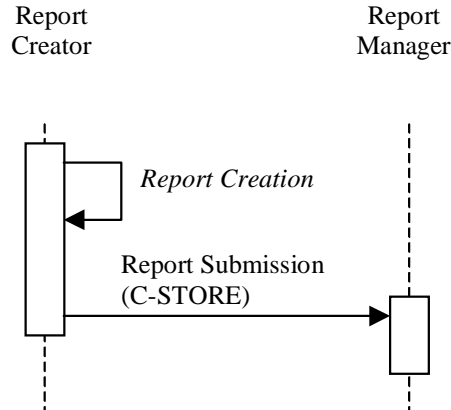This is a local invocation of functions at the Report Creator, and the method used by the Report Creator to obtain report data and create a DICOM Structured Report object is outside the scope of the IHE Technical Framework. The Report Creator shall create a report that conforms to the DICOM Basic Text SR Information Object Definition (IOD) or the DICOM Enhanced SR IOD if numeric values are required in the report. A single Report Creator may support both SR IODs if this is deemed desirable by the implementers.

The report created by the Report Creator can be either in the draft or final state. The Report Creator can also create draft verified reports if necessary. An example of where a draft verified report may be created is on an Ultrasound machine where measurements have been taken. In this case, the user would verify that the measurements, as well as all other report content, are correct in the report created on the Ultrasound machine, but the report is not complete as no diagnosis has been performed.

6.24.4.1.2.1   Coded Entries

All Reporting actors (Report Creator, Report Manager, Report Repository, and External Report Repository Access) must be able to load configurable code tables. The DICOM Structured Report objects are dependent on coded entries to define the concepts being conveyed. The DICOM Committee is currently attempting to standardize commonly used codes in a license-free environment. In the absence of these standard codes, the IHE Committee will define such necessary codes for use in demonstrations. The categories of codes that will be defined, but not limited to, are as follows:

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- Report Titles;
- Report Section Headings;
- Concept Name Codes;
- Observation Context Codes;
- Measurement Codes; and
- Disposition or Conclusion Codes.

The types of reports created by the Report Creator are defined in section 5.3.2. At a minimum, the Report Creator shall be able to generate reports based on the Key Image Note (section 5.3.2.1) and optionally the Simple Image Report (section 5.3.2.2) or both. If the Report Creator supports the Enhanced SR Information Object Definition then it shall also support the creation of Simple Image and Numeric Reports (section 5.3.2.3).

6.24.4.1.2.2   Retrieve AE Title

Whenever references to DICOM Composite objects are made within a DICOM Structured Report, it is possible to include the Retrieve AE Title attribute (0008,0054). In the case of the Report Creator, these references will be contained in the Current Requested Procedure Evidence Sequence attribute (0040,A375), or the Pertinent Other Evidence Sequence attribute (0040,A385). If the Report Creator is a standalone actor it is optional for the Retrieve AE Title attribute (0008,0054) to be sent and it is up to the implementation to determine what value to send. If the Report Creator is combined with an Image Display, then it is recommended that the Retrieve AE Title attribute (0008,0054) be set to the AE Title of the device from which the Image Display retrieved the referenced DICOM Composite objects.

6.24.4.1.2.3   Identical Documents Sequence

Sometimes a single report refers to multiple studies. For example, a patient involved in a collision may require x-rays of both the wrist and leg. These may be ordered as separate studies, but the Radiologist may report on both studies at the same time. To handle this situation in the DICOM Hierarchical Model, it is necessary to duplicate the report within each study. If a Report Creator is generating a single report for multiple studies, it shall create multiple copies of the report, with different SOP Instance UIDs for each study and use the Identical Documents Sequence attribute (0040,A525) in each report. The Identical Documents Sequence attribute (0040,A525) in each report will reference each of the other identical reports in the other studies. The actual content of the report, that is, the SR Document General Module attributes (except the Identical Documents Sequence attribute) and the SR Document Content Module attributes, will be the same in each report instance.

The Retrieve AE Title attribute (0008,0054) in the Identical Documents Sequence Items shall not be sent.

6.24.4.1.3   Expected Actions

Creation of DICOM Structured Report objects ready for storage to the Report Manager.

6.24.4.2 Report Submission

This transaction relates to the "DICOM C-STORE" event between the Report Creator and Report Manager in the above interaction diagram.

6.24.4.2.1 Trigger Events

When report authoring is completed and the Report Creator creates new DICOM Structured Reports, the Report Creator shall transfer DICOM Structured Reports to the Report Manager within one or more DICOM associations.

6.24.4.2.2 Message Semantics

The Report Creator uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Creator is the DICOM Storage SCU of the Basic Text SR Storage SOP Class or the Enhanced SR Storage SOP Class or both. The Report Manager is the DICOM Storage SCP of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. In accordance with the DICOM Standard for SR the Report Manager must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

6.24.4.2.3 Expected Actions

The Report Manager will store the received DICOM Structured Report objects. At this point the Report Creator relinquishes any responsibility for the report objects and may not change them in any way without creating a new object with a new SOP Instance UID.

6.25   Report Issuing

This section corresponds to Transaction 25 of the IHE Technical Framework: Year 2. Transaction 25 is required for the Report Manager and Report Repository actors.

6.25.1   Scope

In the Report Issuing transaction, the Report Manager transmits either an unchanged draft DICOM Structured Report (created by a Report Creator) or a new modified DICOM Structured Report to the Report Repository or both. The Report Manager handles all state and content changes to DICOM Structured Reports and with each change new DICOM Structured Report objects are created and may be stored in the Report Repository.

6.25.2   Use Case Roles
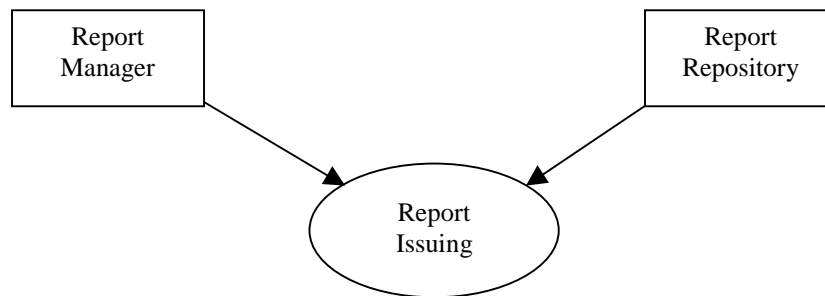
Actor: Report Manager

Role: Process report changes and transmit reports to Report Repository. This involves the ability to handle content and state changes to DICOM Structured Reports and create new DICOM Structured Reports based on these changes. Examples of the types of changes the Report Manager needs to process are as follows:

- Verifying a draft report and setting the verification attributes in the newly created verified report;
- Creating a new unverified report based on one or more previous draft or verified reports;
- Creating a new verified report based on one or more previous draft or verified reports; and
- Creating a new report that is the result of merging multiple previous reports.

Actor: Report Repository

Role: Accept and store DICOM Structured Reports from Report Managers.

6.25.3   Referenced Standards

DICOM Supplement 23: Structured Reporting Storage SOP Classes (Final Text)

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6.25.4   Interaction Diagram
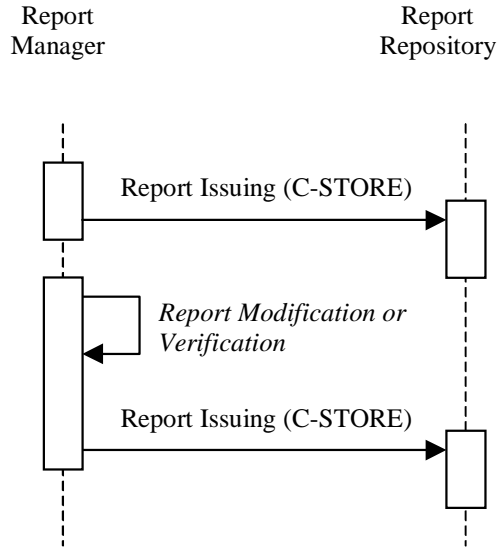
6.25.4.1   Report Issuing (Step 1)

This transaction relates to the top "DICOM C-STORE" event between the Report Manager and Report Repository in the above interaction diagram.

6.25.4.1.1   Trigger Events

When DICOM Structured Reports are received from the Report Creator, the Report Manager can transfer the DICOM Structured Reports to the Report Repository within one or more DICOM associations. This capability should be configurable as it may enable access to reports before they are verified and finalized. Some sites may require this feature, while others may find it undesirable.

6.25.4.1.2   Message Semantics

The Report Manager uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Manager is the DICOM Storage SCU of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. It is required that if a Report Manager is an SCP of the Enhanced SR Storage SOP Class (see section 6.24) then it shall also be an SCU of the Enhanced SR Storage SOP Class. The Report Repository is the DICOM Storage SCP of both the Basic Text SR Storage SOP Class and the Enhanced SR Storage SOP Class. In accordance with the DICOM Standard for SR, the Report Repository must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

6.25.4.1.3   Expected Actions

The Report Repository will store the received DICOM Structured Report objects.

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6.25.4.2   Report Modification

This transaction relates to the "Report Modification or Verification" event in the above interaction diagram.

6.25.4.2.1   Trigger Events

The user at the Report Manager selects an existing report and decides to make some modification to this report.

6.25.4.2.2   Invocation Semantics

This is a local invocation of functions at the Report Manager, and the method used by the Report Manager to specify report state transitions or obtain modified report data and create a new DICOM Structured Report object is outside the scope of the IHE Technical Framework. The Report Manager shall create a report that conforms to the DICOM Basic Text SR Information Object Definition or the DICOM Enhanced SR Information Object Definition if numeric values are to be included in the report either by their addition by the Report Manager or numeric values appeared in the original report received from the Report Creator. It is required that if a Report Manager can receive Enhanced SR objects, that it can also manage such objects and generate new Enhanced SR objects. If the Report Manager removes numeric values from a report it may convert an Enhanced SR object into a Basic Text SR object. When the Report Manager creates a new modified report it must be in a different series to the original report, unless the Report Manager and Report Creator are the same device. This is because the DICOM Standard requires that objects created by different devices must be in different series (i.e., different DICOM General Equipment Module attributes). In order to reference the original report, the new modified report must correctly contain the Predecessor Documents Sequence attribute (0040,A360).

The types of external state changes the Report Manager shall handle are:

- completing a partial report; and
- verifying a report.

To complete a partial report, additional content may be added to the original report and the Completion Flag attribute (0040,A491) shall be set to "COMPLETE". To verify a report, the content of the original report is checked for correctness, and the Verification Flag attribute (0040,A493) shall be set to "VERIFIED". This also requires that the Verifying Observer Sequence attribute (0040,A073) is completed appropriately.

The types of reports that at a minimum shall be handled by the Report Manager are defined in section 5.3.2. The Report Manager shall be able to manipulate reports based on the Key Image Note (section 5.3.2.1) and the Simple Image Report (section 5.3.2.2). If the Report Manager supports the Enhanced SR Information Object Definition then it shall also support manipulation of Simple Image and Numeric Reports (section 5.3.2.3). Even though the IHE Technical Framework sets boundaries on the complexity of SR objects, the Report Manager must still be able to receive and store any Basic Text SR object and optionally any Enhanced SR object in

order to conform to the DICOM Standard. An implementation may restrict the modification capabilities for reports more complex than those specified in section 5.3.2.

There are many reasons and methods for the Report Manager to modify the content of a report and these are outside the scope of the IHE Technical Framework. Examples of the types of changes, in addition to the state changes above, that the Report Manager needs to be able to process are as follows:

- Creating a new report based on one or more previous draft or verified reports where data is changed or added;
- Creating a new report that is the result of merging multiple previous reports. This can also involve changing or adding report data; and
- Converting a Basic Text SR into an Enhanced SR if the Report Manager adds measurements. This also means that if a Basic Text SR is merged with an Enhanced SR then the resulting object will be an Enhanced SR.

It is recommended that amendments to DICOM Structured Reports are made by creating a new DICOM Structured Report object containing the original content as well as any amendments or additions. References to the original report are made by the Predecessor Document Sequence attribute (0040,A360).

6.25.4.2.2.1 Retrieve AE Title

Whenever references to DICOM Composite objects are made within a DICOM Structured Report, it is possible to include the Retrieve AE Title attribute (0008,0054). In the case of the Report Manager, these references will be contained in the Predecessor Documents Sequence attribute (0040,A360), as well as the Current Requested Procedure Evidence Sequence attribute (0040,A375) and the Pertinent Other Evidence Sequence attribute (0040,A385) if these evidence sequence attributes are used by the Report Creator.

The Report Creator may send reports to the Report Manager where the Retrieve AE Title attribute (0008,0054) in the Current Requested Procedure Evidence Sequence Items (0040,A375), or the Pertinent Other Evidence Sequence Items (0040,A385) is empty or not sent. In these cases the Report Manager may add the AE Title of a configured Image Manager in the Retrieve AE Title attribute (0008,0054) of these sequence items.

When the Report Manager creates a new report based on one or more previous reports that it has already stored in the Report Repository, then the AE Title of the Report Repository shall be used as the Retrieve AE Title attribute (0008,0054) in the Predecessor Documents Sequence Items (0040,A360). If the prior reports have not been stored in the Report Repository then the Retrieve AE Title attribute (0008,0054) shall not be sent.

6.25.4.2.2.2 Identical Documents Sequence

When the Report Manager is modifying a report that contains items in the Identical Documents Sequence attribute (0040,A525) then a decision is needed as to the actions to occur upon the other identical documents. The user modifying the report should be asked as to whether the changes should only apply to the current report or to the other identical documents as well. If the

changes are limited to one report, then no Identical Documents Sequence attribute (0040,A525) shall be included in the new report as it is no longer the same as the other documents. If the changes are to apply to multiple reports, then multiple new reports with new SOP Instance UIDs shall be created with the new report data and their Identical Documents Sequence attribute (0040,A525) shall refer to the appropriate new report objects. Also in this case each Predecessor Documents Sequence attribute (0040,A360) shall refer to all the original identical documents. This is shown in figure 6.25-1.
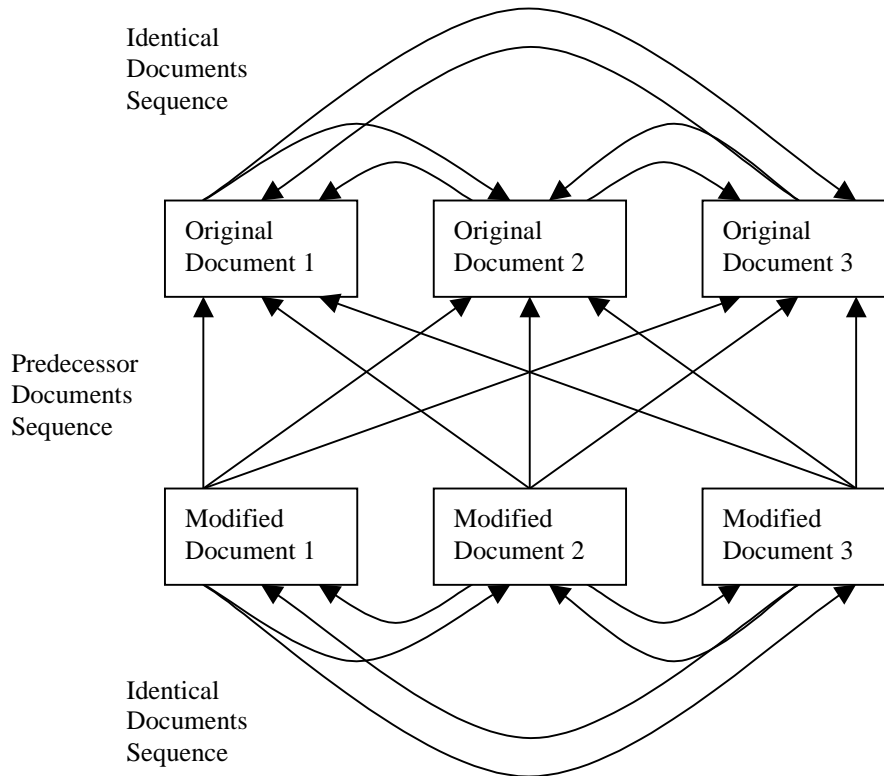
Figure 6.25-1. Identical and Predecessor Document Sequences

6.25.4.2.3   Expected Actions

Creation of a new modified DICOM Structured Report object ready for storage to the Report Repository.

6.25.4.3   Report Issuing (Step 2)

This transaction relates to the bottom "DICOM C-STORE" event between the Report Manager and Report Repository in the above interaction diagram.

6.25.4.3.1   Trigger Events

When reports are finalized (complete and verified) they shall be stored in the Report Repository. The Report Manager can transfer DICOM Structured Reports to the Report Repository within

one or more DICOM associations. Internal reports shall be temporarily stored in the Report Manager until they are finalized, but may also be stored permanently in the Report Repository if the Report Manager decides to transfer them. The technique used by the Report Manager to finalize a report is outside the scope of the IHE Technical Framework.

6.25.4.3.2   Message Semantics

The Report Manager uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Manager is the DICOM Storage SCU of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. It is required that if a Report Manager is an SCP of the Enhanced SR Storage SOP Class (see section 6.24) then it shall also be an SCU of the Enhanced SR Storage SOP Class. The Report Repository is the DICOM Storage SCP of both the Basic Text SR Storage SOP Class and the Enhanced SR Storage SOP Class. In accordance with the DICOM Standard for SR the Report Repository must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

6.25.4.3.3   Expected Actions

The Report Repository will store the received DICOM Structured Report objects.

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6.26   Query Report

This section corresponds to Transaction 26 of the IHE Technical Framework: Year 2. Transaction 26 is required for the Report Repository, Report Reader, and External Report Repository Access actors.

6.26.1   Scope

In the Query Report Transaction, the Report Reader queries the Report Repository or External Report Repository Access for draft or final DICOM Structured Reports.

6.26.2   Use Case Roles
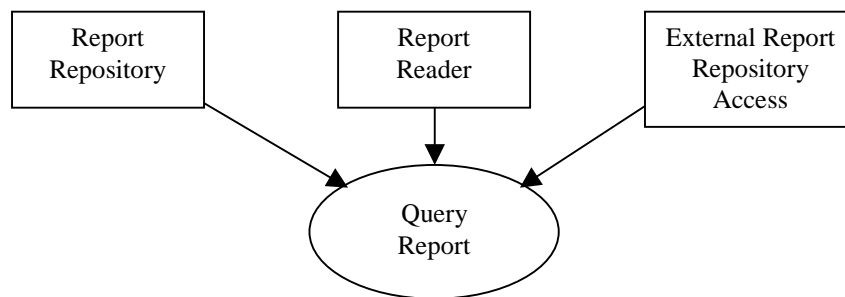
Actor: Report Repository

Role: Responds to queries for DICOM Structured Reports.

Actor: External Report Repository Access

Role: Responds to queries for DICOM Structured Reports. This system provides storage of DICOM Structured Reports obtained from outside the Radiology department. Such a system may be required to convert reports of different formats (HL7) into DICOM Structured Reports (see appendix E).

Actor: Report Reader

Role: Queries Report Repository or External Report Repository Access for DICOM Structured Reports and makes them available for selection.

6.26.3   Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class

DICOM Supplement 23: Structured Reporting Storage SOP Classes (Final Text)

6.26.4   Interaction Diagram
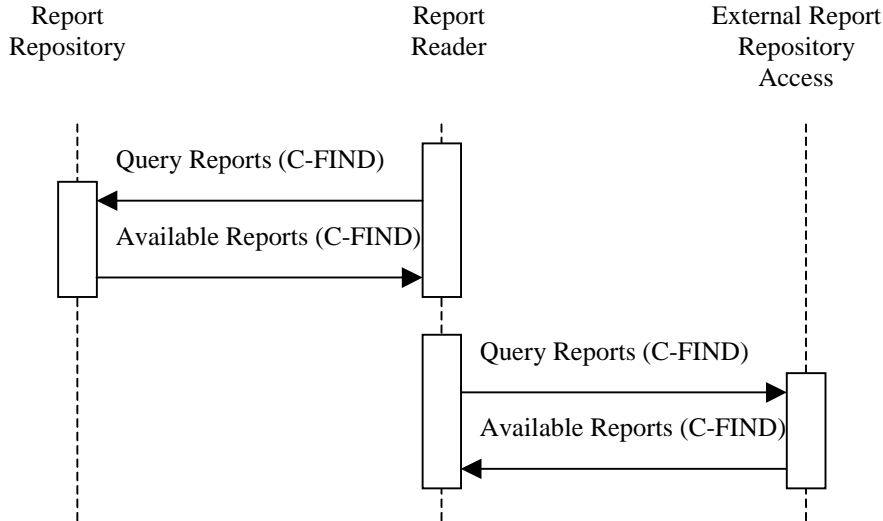
6.26.4.1   Query Reports

This transaction relates to the query section of the above interaction diagram. The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes will be supported. Refer to DICOM 1999 PS 3.4: Query/Retrieve Service Class for detailed descriptive semantics.

6.26.4.1.1   Trigger Events

The user at the Report Reader wishes to view selected reports.

6.26.4.1.2   Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Report Reader to the Report Repository or External Report Repository Access.

The Report Reader uses one or more matching keys as search criteria to obtain the list of matching entries in the Report Repository or External Report Repository Access at the selected level (Patient & Study/Series/Instance).

In addition to the required and unique keys defined by the DICOM Standard, the IHE Technical Framework has defined matching and return keys to be supported by query SCU and SCPs. The keys are defined in section 6.14.4.1.2 and table 6.14-1 while the conventions for key usage are defined in section 2.2. For the Report Reader (SCU) and the Report Repository and External Report Repository Access (SCP) the additional SR Instance specific keys are defined in table 6.26-1.

Table 6.26-1. SR Instance Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
SR Instance Specific Level					
Completion Flag	(0040,A491)	R+	R+	R+	R+
Verification Flag	(0040,A493)	R+	R+	R+	R+
Content Date	(0008,0023)	O	O	O	R+
Content Time	(0008,0033)	O	O	O	R+
Observation DateTime	(0040,A032)	O	O	O	R+
Verifying Observer Sequence	(0040,A073)	R+	R+	R+	R+
>Verifying Organization	(0040,A027)	O	O	R+	R+
>Verification DateTime	(0040,A030)	R+	R+	R+	R+
>Verifying Observer Name	(0040,A075)	R+	R+	R+	R+
>Verifying Observer Identification Code Sequence	(0040,A088)	O	O	R+	R+
Referenced Request Sequence	(0040,A370)	O	O	R+	R+
>Study Instance UID	(0020,000D)	O	O	R+*	R+
>Accession Number	(0008,0050)	O	O	R+	R+
>Requested Procedure ID	(0040,1000)	O	O	R+	R+
>Requested Procedure Code Sequence	(0032,1064)	O	O	O	R+
>>Code Value	(0008,0100)	O	O	O	R+
>>Coding Scheme Designator	(0008,0102)	O	O	O	R+
>>Coding Scheme Version	(0008,0103)	O	O	O	R+
>>Code Meaning	(0008,0104)	O	O	O	R+
Concept Name Code Sequence	(0040,A043)	R+	R+	R+	R+
>Code Value	(0008,0100)	R+	R+	R+	R+
>Coding Scheme Designator	(0008,0102)	R+	R+	R+	R+
>Coding Scheme Version	(0008,0103)	O	O	O	R+
>Code Meaning	(0008,0104)	O	O	R+	R+

6.26.4.1.3   Expected Actions

The Report Repository or External Report Repository Access receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Report Reader via C-FIND responses.

6.27   Retrieve Reports

This section corresponds to Transaction 27 of the IHE Technical Framework: Year 2. Transaction 27 is required for the Report Repository, Report Reader, and External Report Repository Access actors.

6.27.1   Scope

In the Retrieve Report Transaction, the requested DICOM Structured Reports are transferred from the Report Repository or External Report Repository Access to the Report Reader for viewing.

6.27.2   Use Case Roles
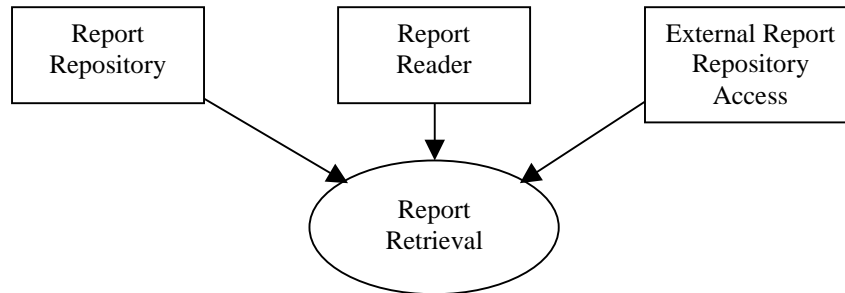
Actor: Report Repository

Role: Sends requested DICOM Structured Reports to Report Reader.

Actor: External Report Repository Access

Role: Sends requested DICOM Structured Reports to Report Reader. Such a system may be required to convert reports of different formats (HL7) into DICOM Structured Reports (see appendix E).

Actor: Report Reader

Role: Retrieves DICOM Structured Reports from Report Repository or External Report Repository Access and makes them available for viewing.

6.27.3   Referenced Standards

DICOM 1999 PS 3.4: Query/Retrieve Service Class

DICOM Supplement 23: Structured Reporting Storage SOP Classes (Final Text)

6.27.4   Interaction Diagram
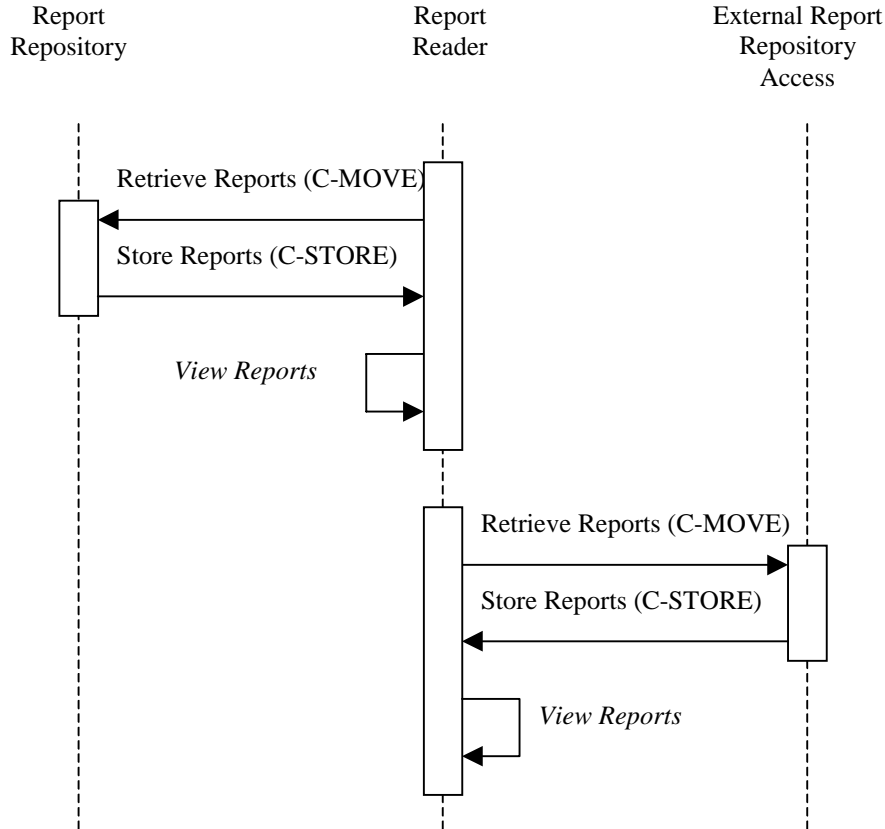
6.27.4.1   Retrieve Reports

This transaction relates to the retrieve section of the above interaction diagram. The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes will be supported. The DICOM Basic Text SR Storage SOP Class and optionally the DICOM Enhanced SR Storage SOP Class will be supported by the Report Reader as an SCP. Both the DICOM Basic Text SR Storage SOP Class and the DICOM Enhanced SR Storage SOP Class will be supported by the Report Repository as an SCU. The DICOM Basic Text SR Storage SOP Class and optionally the DICOM Enhanced SR Storage SOP Class will be supported by the External Report Repository Access as an SCU. Refer to the DICOM Standard (PS 3.4, Annex C, and Supplement 23) for detailed descriptive semantics.

6.27.4.1.1   Trigger Events

The user at the Report Reader selects specific reports to view.

6.27.4.1.2   Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Structured Report Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class or the DICOM Patient Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the Report Reader to the Report Repository or External Report Repository Access.

6.27.4.1.3 Expected Actions

The Report Repository or External Report Repository Access receives the C-MOVE request, establishes a DICOM association with the Report Reader and uses the appropriate DICOM Structured Report Storage SOP Classes (Basic Text SR Storage SOP Class and/or Enhanced SR Storage SOP Class) to transfer the requested reports.

6.27.4.2 View Reports

This transaction relates to the "View Reports" event of the above interaction diagram.

6.27.4.2.1 Trigger Events

The Report Reader receives reports from the Report Repository or External Report Repository Access.

6.27.4.2.2 Invocation Semantics

This is a local invocation of functions at the Report Reader, and the method used by the Report Reader to interpret and display the report data in a meaningful way is outside the scope of the IHE Technical Framework. At a minimum the Report Reader shall be able to correctly display reports defined in section 5.3.2. The Report Reader shall be able to display reports based on the Key Image Note (section 5.3.2.1) and the Simple Image Report (section 5.3.2.2). If the Report Reader supports the Enhanced SR Information Object Definition then it shall also support display of Simple Image and Numeric Reports (section 5.3.2.3). Even though the IHE Technical Framework sets boundaries on the complexity of SR objects, the Report Reader must still be able to receive, store and view any Basic Text SR object and optionally any Enhanced SR object in order to conform to the DICOM Standard. An implementation may not be able to render, in a meaningful way, reports more complex than those specified in section 5.3.2.

If a DICOM Structured Report references other DICOM composite objects, such as images, and softcopy presentation states, it is optional for the Report Reader to actually retrieve and display/apply these objects, but the Report Reader must convey to the user that such references exists in the report.

6.27.4.2.2.1 Retrieve AE Title

If the Report Reader is grouped with an Image Display and capable of retrieving objects referenced in a DICOM Structured Report then the Report Reader should retrieve these objects from the device matching the appropriate Retrieve AE Title attribute (0008,0054) included in the DICOM Structured Report. If the Retrieve AE Title attribute is not specified or configured, then the Report Reader should use some other configurable Retrieve AE Title.

6.27.4.2.3   Expected Actions

The Report Reader presents to the user a DICOM Structured Report.

Appendix A: Clarification of Accession Number and Requested Procedure ID

The purpose of this appendix is to clarify the entity relationship and role of the Accession Number and the Requested Procedure ID.

A.1: Definition of Accession Number

The Accession Number attribute is defined in the DICOM Imaging Service Request Entity. The IHE Framework has chosen to equate the DICOM Imaging Service Request and the HL7 Filler Order Entities. A subset of the IHE Integrated Data Model Entity Relationship (ER) and keys are as follows:

Departmental link to the order entry system:

Filler Order/Imaging Service Request
Filler Order Number (U)
Accession Number (U)

1:n

Intradepartmental information (e.g., reporting, charging, etc.):

Requested Procedure
Accession Number (FK)
Study Instance UID (U)
Requested Procedure ID (U)

1:n

Procedure scheduling and acquisition definition level:

Scheduled Procedure Step
Study Instance UID (FK)
Requested Procedure ID (FK)
Scheduled Procedure Step ID (U)
Modality
Scheduled Step Start Date/Time

Figure A.1-1. Subset of IHE Data Model

In the healthcare industry today, the term Accession Number (or Requisition Number) is used inconsistently to refer either to a collection of Requested Procedures (a Filler Order) or to a single Requested Procedure. In the IHE model defined above, the Accession Number is a collector of Requested Procedures and thus of reports as well as imaging studies.

Institutions that use Accession Number in the role of Requested Procedure ID face problems managing complex procedures involving multiple modalities since they must rely on a simplified data model (1-to-1: Imaging Service Request contains just one procedure). In the IHE model, the Accession Number can reference multiple Requested Procedures. It follows also that in the IHE model the Accession Number can contain multiple Study Instance UIDs.

The IHE Framework views the relationship of the Accession Number as the user-friendly representation of the Filler Order Number, and the Requested Procedure ID as the user-friendly representation of the Study Instance UID within an institution.

The specific correlation between the Accession Number and Filler Order Number, as well as the correlation between the Requested Procedure ID and the Study Instance UID, is an implementation matter that is left to each system.

The relationship of the Accession Number and the Requested Procedure ID can be enumerated as follows:

Case 1 (Simple Case):

Accession Number : Requested Procedure ID is 1:1.
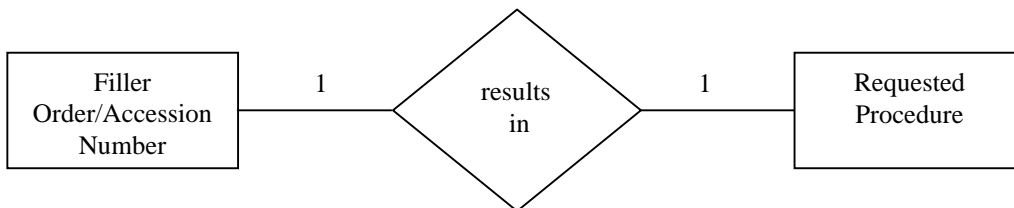
An example of case 1 is an order of an "MR head" which results in a single Requested Procedure. A single report may be generated for the order.

Case 2:

Accession Number : Requested Procedure ID is 1:1 - Requested Procedure level is expanded with modalities integrated with departmental information system via MWL.
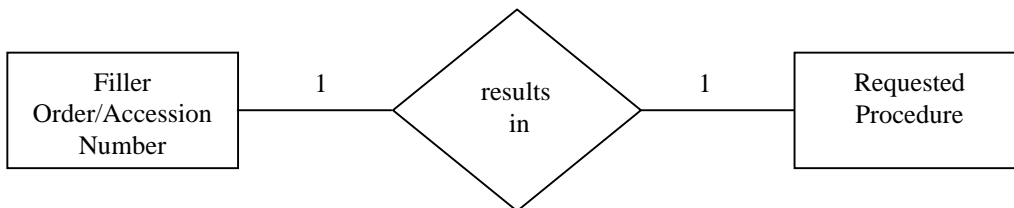
An example of case 2 is an order of "cardiac stress" which results in a multimodality Requested Procedure (recall that Modality is specified at the Scheduled Procedure Step level). The "cardiac

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stress" Requested Procedure may result in a NM and a MR Scheduled Procedure Step. Both the MR study and the NM study should have the same Accession Number, Requested Procedure ID, and Study Instance UID. A single report is generated for the order.

Another example of case 2 is an order for a "Nuclear stress" which results in two separate acquisitions on the nuclear system, separated by six hours in time. Again, both image acquisitions would ideally have the same Accession Number, Requested Procedure ID, and Study Instance UID. A single report may be generated for the order.

Case 3:

Accession Number : Requested Procedure ID is 1:1 – Requested Procedure level is expanded, but modality does not have MWL resulting in a 1:n relationship

```
┌─────────────┐         ╱╲              ┌─────────────┐
│   Filler    │   1    ╱    ╲    n      │  Requested  │
│Order/Access-│───────<results >───────│  Procedure  │
│ion Number   │        ╲  in ╱         │             │
└─────────────┘         ╲  ╱            └─────────────┘
                         ╲╱
```

An example of case 3 would be the same "cardiac stress" resulting in a multimodality Requested Procedure, but in a department where the modalities have not implemented MWL (and therefore do not receive the Accession Number, Requested Procedure ID, nor Study Instance UID from the departmental information system). Because the image acquisitions have different Study Instance UIDs at the Requested Procedure level, the acquisitions are effectively grouped at the Filler Order/Imaging Service Request level. If both acquisition devices are able to incorporate the Requested Procedure ID, a single report may be generated. If two different Requested Procedure IDs are also used, then two reports may be generated.

Note that MWL is a required transaction of the IHE Technical Framework; this example is given for illustrative purposes.

Case 4:

Accession Number : Requested Procedure ID is 1:n – An Accession Number/Filler Order generates n Requested Procedures

```
┌─────────────┐         ╱╲              ┌─────────────┐
│   Filler    │   1    ╱    ╲    n      │  Requested  │
│Order/Access-│───────<results >───────│  Procedure  │
│ion Number   │        ╲  in ╱         │             │
└─────────────┘         ╲  ╱            └─────────────┘
                         ╲╱
```
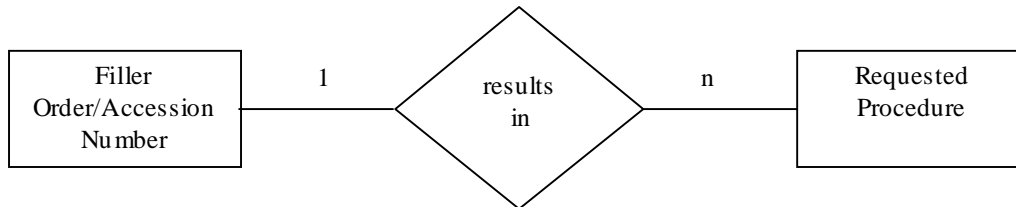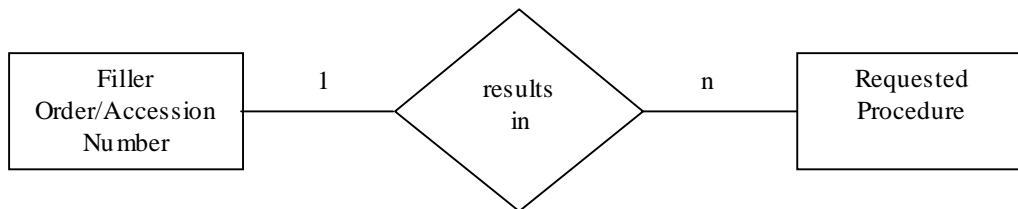
An example of case 4 would be the same "cardiac stress" as above, but where the departmental information system creates several Requested Procedures, one for each modality. In this example, the image studies will be assigned the same Accession Number, but different Requested Procedure IDs and Study Instance UIDs. In this case, separate reports may be generated for each Requested Procedure.

Another example of case 4 would be a simple broken arm case. In this example, the Filler Order could be "radiology study of the arm". The Requested Procedure could be "X-ray study - right arm". The Scheduled Procedure Step could be "A/P and lateral of the right arm". Typically, there is a follow up radiology exam performed six weeks after the broken arm incident. This follow up study, if ordered along with the initial study, could have the same Accession Number as the previous study, but a new Requested Procedure ID, new Study Instance UID, and a new Scheduled Procedure Step ID.

A.2:   Impact on Current Implementations

In the DICOM Model, the departmental information system, which is usually acting as the DICOM Modality Worklist SCP, creates the following keys (not a comprehensive list):

- Accession Number - Filler Order/Imaging Service Request level
- Study Instance UID - Requested Procedure level
- Requested Procedure ID - Requested Procedure level
- Scheduled Procedure Step ID - Scheduled Procedure Step level

The departmental information system that does not support multiple Requested Procedures per Filler Order has the option to manage the Accession Number : Requested Procedure ID relationship as 1:1. In this case, the implementation of the Requested Procedure ID may be as simple as copying the currently implemented Accession Number into the DICOM Requested Procedure ID field on the fly during the creation of the MWL response.

Alternatively, the departmental information system has the flexibility to create the Accession Number : Requested Procedure ID relationship as 1:n. An example of this would be a Filler Order that requires both a Nuclear Medicine and an MR acquisition as part of the same "study". In this case, both acquisitions will be scheduled as separate Scheduled Procedure Steps of the same procedure and should be provided the same information for Accession Number, Study Instance UID, and Requested Procedure ID keys as part of the MWL response. If, however, either the NM or MR acquisition devices has not implemented MWL SCU, (and assuming there is a user interface field on the scanners to input Accession Number) the departmental information system can still link these two seemingly separate acquisitions with different Study Instance UIDs using the Accession Number. Note that MWL is a required transaction of the IHE Technical Framework; this example is given for illustrative purposes.

A.3:   User Education

The radiology user community first has to be educated on the five levels of the ER model as used by IHE, and the key identifiers for each of those levels. If this can be expressed in such a way that the users understand the difference between Accession Number and Requested Procedure ID, an evolution in terminology will have to take place at institutions where the term "Accession Number" is currently used at the Requested Procedure level.

The MWL implementer community will have to be educated on the usage of the key identifiers and why it is important to use and retain the correct information at the correct levels. This may include both database as well as user interface changes.

Key points to be illustrated are that the Requested Procedure ID is more important on an acquisition system/scanner than is the Accession Number.

A.4:   Rationale

The following items were unanimously agreed upon:
- There are five ER levels necessary for IHE: Patient, Placer Order, Filler Order, Requested Procedure, and Scheduled Procedure Step/Modality Performed Procedure Step
- The Requested Procedure entity tracks from scheduling through interpretation
- The Requested Procedure level is the "charging" and "reporting" level
- The Filler Order Number and the Study Instance UID are not user friendly and not intended for GUI display (are intended for computers to use)
- The Accession Number is a user-visible number on the Department System Scheduler

There were two options:
1. Map Accession Number to Requested Procedure ID at the Requested Procedure Level
2. Map Accession Number to Filler Order Number

Benefits of option 1:
- Requested Procedure ID is easier to map to DICOM Accession Number (note that Filler Order number is comprised of 4 components in HL7).
- The user interface at the modalities may not have to change.

Benefits of option 2:
- There would be no changes to the DICOM Standard. Changing the entity relationship of the Accession Number to the Study Instance UID would require a new MWL SOP class in DICOM and could potentially negate the current momentum behind the MWL implementations in the field.
- There are systems in place with data using the 1:n relationship between Accession Number: Study Instance UID. This would be nearly impossible to re-map.
- There are modalities which do not support MWL and therefore effectively implement the 1:n relationship between Accession: Study Instance UID (i.e., the modalities still generate their own Study Instance UID).
- Requested Procedure ID is a "clean" field without connotation in the field today.

Conclusion:

Both options 1 and 2 have the drawbacks of having to educate the user and development community on the refined usage of Accession Number. The arguments for option 2 were deemed stronger and this option was selected for the reasons defined above.

Appendix B: Topics for Standards Corrections or Supplements

B.1:   HL7 Topics

The IHE Technical Framework: year 2 defines a ZDS Segment as a temporary solution for handling Study Instance UID. A request has been sent to the IMSIG of HL7 for considering an extension of the HL7 standard, which may make its way into version beyond 2.3.1.

B.2:   DICOM Topics

A change Proposal, CP 191, was accepted by DICOM Working group 6 at the March, 2000 meeting to allow the C-FIND SCP to support the Image Availability data element (0008, 0056) to indicate the relative time of retrieval. The value of this tag will be set to ONLINE if corresponding images are in the immediately available storage (cache, RAID), NEARLINE, if images are located in a longer-term storage (CD jukebox, for example), and OFFLINE, if images has to be retrieved from the media not currently in the system (i.e., CD or tape not currently mounted in the jukebox/tape library).

Correction proposal CP 190 has also been accepted byWG6 to support case-insensitive matching for DICOM elements of VR PN in C-FIND requests. This will allow patient names, for example, to be matched without regard to their case.

Both correction proposals mentioned above, though accepted by WG6, need to be balloted by the full DICOM Committee.

Appendix C: Attribute Consistency between Modality Worklist, Composite IODs and Modality Performed Procedure Step

This appendix is an integral part of the IHE Technical Framework. It reflects IHE's adoption of Annex M of Part 4 (PS3.4) of the DICOM Standard. It includes three sections:

- The first section contains the summary table of PS3.4 Annex M and its notes with IHE clarifications. IHE requires that the Attribute mapping defined in this table be supported by Modality Actors as they implement MWL, various IOD Storage and PPS SOP Classes for Transactions 6, 7, 20 and 21. A number of IHE notes have been added to this DICOM Table (IHE-x) to restate some of the DICOM Annex M requirements as well as select some of the choices offered or enforce some of the recommendations of DICOM. A few additional IHE recommendations are also specified.

- The second section extends this table with additional IHE Requirements based on a number of critical attributes (Type 2 in DICOM) common to most composite instances (Images, Standalone and GSPS IODs).

- The third section introduces a real-world data model of the entities and their Attributes related to consistency. Readers are advised to use this data model along with the table presented in section 4. This data model is provided only for ease of understanding and does not introduce any additional IHE requirements.

C.1: Integration-critical Attributes

The table below shall be interpreted as follows:

- An Attribute shown in the first column, shall be requested by a MWL SCU (Acquisition Modality) as a return key in its C-FIND Requests. Attribute Values shall be returned in the Modality Worklist C-FIND response by the Department System Scheduler.

- The return Attribute Values shall be used by the Acquisition Modality in filling the Attribute shown on the corresponding line of table C-1 both for Composite Instances (second column) and MPPS Instances.

- The PPS Manager, Image Manager and Department System Scheduler roles shall be capable of handling the Attributes shown in the corresponding line of the third column as defined by the SCP Type and the additional notes.

- Mappings which are critical to maintaining the relationship between information objects distributed among IHE Actors have been highlighted with a bolded border. Non Bolded Attributes are not critical to maintaining relationships between objects, but are nonetheless important from an information distribution point of view.

- IHE requirements specified in IHE notes extend or clarify DICOM requirements (e.g. TYPE 3 Attributes are required under specific circumstances; DICOM recommendations are mandated).

Table C-1. Comparison of Corresponding Attributes of Modality Worklist Information Model, Image and Standalone IODs and Modality Performed Procedure Step IOD

Modality Worklist [Return Key Type] (e) (IHE-9)	Images and Standalone IOD[Type]	MPPS IOD [SCU/SCP Type]
----	----	Scheduled Step Attributes Sequence [1/1] (c)
Study Instance UID [1]	Study Instance UID [1] (IHE-1)	>Study Instance UID [1/1] (IHE-2) (IHE-20)
Referenced Study Sequence [2] (d)	Referenced Study Sequence [3] (c) (IHE-18)	>Referenced Study Sequence [2/2] (f) (IHE-3)
Accession Number [2] (IHE-13)	Accession Number [2] (IHE-7)	>Accession Number [2/2] (IHE-4)
----	Request Attributes Sequence [3] (a,c) (IHE-11)	----
Requested Procedure ID [1]] (IHE-13)	>Requested Procedure ID [1C]	>Requested Procedure ID [2/2]
Scheduled Procedure Step ID [1] (IHE-14)	>Scheduled Procedure Step ID [1C]	>Scheduled Procedure Step ID [2/2]
Scheduled Procedure Step Description [1C] (IHE-15)	>Scheduled Procedure Step Description [3]	>Scheduled Procedure Step Description [2/2]
Scheduled Action Item Code Sequence [1C] (IHE-15)	>Scheduled Action Item Code Sequence [3]	----
----	Performed Action Item Code Sequence [3] (IHE-10) (IHE-19)	Performed Action Item Code Sequence [2/2] (IHE-10)
----	Study ID [2] (IHE-5)	Study ID [2/2]
----	Performed Procedure Step ID [3] (b)	Performed Procedure Step ID [1/1]
----	Performed Procedure Step Start Date [3] (b) (IHE-8)	Performed Procedure Step Start Date [1/1]
----	Performed Procedure Step Start Time [3] (b) (IHE-8)	Performed Procedure Step Start Time [1/1]
----	Performed Procedure Step Description [3] (IHE-8)	Performed Procedure Step Description [2/2]
Requested Procedure Description [1C] (IHE-16)		
Requested Procedure Code Sequence [1C] (IHE-16)	----	Procedure Code Sequence [2/2] (IHE-6)
----	Referenced Study Component Sequence [3] (d) (IHE-12)	----
----	>Referenced SOP Class UID [1C]	SOP Class UID [1/1]
----	>Referenced SOP Instance UID [1C]	SOP Instance UID [1/1]
----	Protocol Name [3] (IHE-17)	Protocol Name [1/1]

Adapted from DICOM PS 3.4 1998, Annex M, p. 243.

(a)   Recommended if the Modality conforms as a SCU to the Modality Worklist SOP Class and Modality Performed Procedure Step SOP Class

(b)   Recommended if the Modality conforms as a SCU to the Modality Performed Procedure Step SOP Class

(c)   Sequence may have one or more Items

(d)   Sequence may have only one Item

(e)   Worklist may have one or more Items related to one Modality Performed Procedure Step (IHE-9).

(f)   Referenced Study Sequence may have only one item. If more Study Sequences are related to the Modality Performed Procedure Step, additional Scheduled Step Attribute Sequence items must be created.

(IHE-1) A Study Instance UID needs to be created by the Acquisition Modality (One of the options defined by PS3.4 Annex M section M.4.1) when several SPS belonging to different Requested Procedures are satisfied by a single PPS or when a PPS is unscheduled.

(IHE-2) When a PPS is unscheduled (i.e. no SPS and Requested procedure), the Study Instance UID in the Scheduled Step Attribute Sequence (a single item) needs to contain the Study Instance UID created by the equipment for the Study Instance UID of the Image and stand-alone IODs it creates (See PS3.4 Annex M, section M6).

(IHE-3) A Zero Length Referenced Study Sequence (One of the options proposed by PS3.4) needs to be created when a PPS is unscheduled (i.e. no SPS and Requested procedure).

(IHE-4) A Zero Length Accession Number (One of the options proposed by PS3.4 Annex M) needs be created when a PPS is unscheduled (i.e. no SPS, Requested procedure, Imaging Service Request)

(IHE-5) It is recommended to use Requested Procedure ID as Study ID in Image and stand-alone IODs (Unless the PPS was unscheduled or several SPS are grouped into a single PPS. In this case it could be equipment generated).

(IHE-6) It is recommended to set the Procedure Code Sequence to zero length when the Performed Action Items differ from the Scheduled Action Item Code Sequence.

(IHE-7) A Zero Length Accession Number (One of the options proposed by PS3.4 Annex M section M.4.1) shall be created when a PPS is unscheduled (i.e. no SPS, Requested Procedure, Imaging Service Request) or when a PPS results from several SPS attached to different Imaging Service Requests (i.e. different Accession Numbers).

(IHE-8) Image and stand-alone IODs are recommended to use the values of Performed Procedure Step Description, Performed Procedure Step Start Date and Performed Procedure Step Start Time for the respective values of Study Description, Study Date and Study Time.

(IHE-9) When several Worklist Items are related to one Modality Performed Procedure Step, this is called by IHE the group case (Supported by DICOM PS3.4 Annex M, see Note (e) above).

(IHE-10) The Performed Action Item Code Sequence may be different from the Scheduled Action Item Code Sequence when it has to be changed by the image producing equipment operator.

(IHE-11) Request Attribute Sequence shall be included if the Modality conforms as a SCU to the Modality Worklist SOP Class and Modality Performed Procedure Step (Per DICOM PS3.4 Annex M recommendation, see Note (a) above), unless the Department System Scheduler providing Modality Worklist service was not accessible.

(IHE-12) The Reference Study Component Sequence (0008,1111) shall be included (Per DICOM PS3.3 section C.7.3.strong recommendation, General Series Module Table, Note 1) when Acquisition Modality Actors support MPPS.

(IHE-13) Accession Number and Requested Procedure ID shall be supported by Modality Worklist SCPs (Department System Scheduler) as matching keys. It is recommended that Requested Procedure IDs be assigned uniquely to identify a Requested Procedure within an Imaging Service Request/Filler Order which is identified by either a Filler Order Number or an Accession Number.

(IHE-14) The Scheduled Procedure Step ID values shall be assigned to at least uniquely identify Scheduled Procedure Steps within a Requested Procedure which is uniquely Identified by its Study Instance UID.

(IHE-15) Scheduled Procedure Step Description and Scheduled Action Item Code Sequence shall both be requested as Return Keys by Acquisition Modality Actors. The Department System Scheduler (MWL SCP) may return either one or both (Per DICOM Type 1C definition).

(IHE-16) Requested Procedure Description and Requested Procedure Code Sequence shall both be requested as Return Keys by Acquisition Modality Actors. The Department System Scheduler (MWL SCP) may return either one or both (Per DICOM Type 1C definition).

(IHE-17) It is recommended that Protocol Name be included in Composite IODs (e.g. Images and stand-alone IODs).

(IHE-18) The Reference Study Sequence shall be absent (Type 3 Attribute) when a PPS is unscheduled (i.e. no SPS and Requested procedure), otherwise, the Sequence shall be present with one or more Items. Each Item shall contain the SOP Instance UID and the SOP Class UID of the Reference Study Sequence received in the MWL. The number of Items shall correspond exactly to the number of SPS grouped for a Performed Procedure Step.

(IHE-19) DICOM CP 138 states that Performed Action Item Sequence will be a type 3 attribute in the General Series Module. The IHE Technical Framework encourages implementations to include this attribute which has been approved and is now included in the 1999 publication of the DICOM Standard.

(IHE-20) When several SPS belonging to different Requested Procedures are satisfied by a single PPS (group case), the Study Instance UID in all the items of the Scheduled Step Attribute Sequence needs to contain the single Study Instance UID created by the equipment for the Image and stand-alone IODs it creates. Note that this requirement is different from the suggestions described in DICOM PS3.4 Annex M, section M6.

C.2:   Context-critical Attributes

This section extends the above table with additional IHE Requirements based on a number of context-critical attributes (Type 2 in DICOM) common to most images and standalone IODs when provided in response to a C-FIND Request in Return Key Attributes. The content of this table is strictly consistent with PS 3.4 Annex M of DICOM.

Modality Worklist [Return Key Type]	Images and Standalone IOD [Type]	MPPS IOD [SCU/SCP Type]
Patient Name [1]	Patient Name [2] (IHE-21)	Patient Name [2/2] (IHE-21)
Patient ID [1]	Patient ID [2] (IHE-21)	Patient ID [2/2] (IHE-21)
Patient's Birth Date [2]	Patient's Birth Date [2] (IHE-22)	Patient's Birth Date [2/2] (IHE-22)
Patient's Sex[2]	Patient's Sex[2] (IHE-22)	Patient's Sex[2/2] (IHE-22)
Referring Physician's Name [2]	Referring Physician's Name [2] (IHE-22)	----

IHE-21 This Attribute may be zero length when the Department System Scheduler/Order Filler providing the Modality Worklist service is not accessible. Pre-registered values for Patient ID and Patient Name will be used in the Unidentified Patient cases defined in the IHE Technical Framework: Year 2.

IHE-22 This Attribute may be zero length when the Department System Scheduler/Order Filler providing Modality Worklist service is not accessible or the Attributes returned by MWL are zero length.

C.3:   Consistency Data Model

The section introduces a data model of the entities and their Attributes related to Consistency. Readers are advised to use this data model along with the table presented in section 1 of appendix C. This data model is provided only for ease of understanding and does not introduce any additional IHE requirements than those specified in section C.2.

Entities are shown by solid line rectangular boxes.

A relationship between two entities is shown by an arrow or a straight line. In the case of straight lines the Attributes used to define this relationship are not described by this model (they are generally well understood). In the case an arrow is used:

- The <u>attribute in the referencing entity</u> used to define this relationship is shown within the entity in a box next to the origin of the arrow (e.g. Ref. St. Seq. in the Requested Procedure Entity is used to link this entity with the Conceptual Study Management entity).

- The <u>referenced attribute</u> is shown at the tip of the arrow also in a rectangular box but with curly brackets (e.g. . . {Study Instance UID} . In some cases the referencing Attribute has a different name than this referenced Attribute. This reflects the way DICOM has elected to name and or encode those Attributes. The number shown between square brackets is the Data Type as defined by DICOM.

The cardinality of relationship is defined both along straight lines and arrows:

- <u>Cardinality of the relationship</u> between the entities is shown along the arrow/lines. The direction of the arrow has no influence on the cardinality definition. This cardinality reflects the cardinality between entities in a <u>real-world data model</u> (used as defined by DICOM). This cardinality may be slightly different in the DICOM Information Object Definition data models as this data-model reflects entity relationship supported in the context of information communication. For example "I-Series to I-Composite" has a 1 to 0-n relationship to reflect that a PPS may contain a series with no Composite Instances (e.g. images, GSPS). However in the context of the DICOM Storage Service Class, a Series must contain at least one Composite Instance (e.g. image, GSPS). In other terms series with no images cannot be stored but can be defined by DICOM Performed Procedure Steps.

Arrows with thick lines reflect the fact that the referencing Attributes are UID (broad uniqueness), as opposed to simple IDs which are shown by thin line arrows.

In this Data Model, two dotted-line boxes are shown:

- The first one groups 4 entities: I-Patient, I-Study, I-Series, I-Composite. This is intended to reflect the fact that Composite Instances are transferred (Storage Service Class) by grouping these four entities. These 4 entities are those defined by DICOM Composite Image Information Model (See PS 3.3, section A.1.2)

- The second one groups 2 entities: Requested Procedure and Conceptual Study Management. This reflects that those two entities are always in a one-to-one relationship. The Requested Procedure entity as well as those associated with it (Patient, Imaging Service Request, Schedule Procedure Step and Performed Procedure Step) are defined by the DICOM Model of the Real World for the purpose of the Modality-IS Interface (See PS3.3, section 7.3). The "Conceptual Study Management" entity is special in that its only attribute in the context of the IHE Technical Framework V3.0 is the Referenced SOP Instance UID (found in Reference Study Sequence). This Conceptual Study Detached Study entity (without the Detached Management Study SOP Class being used) is defined by DICOM in PS3.4 section M.2.

Note: This Referenced SOP Instance UID cannot be assumed to have the same value as the Study UID in the Requested Procedure UID. Although these two entities are in a one-to-one

relationship they are not constrained to use the same value of UID. This flexibility is allowed by the DICOM Standard and carefully preserved by the IHE Technical Framework.

*** This relationship may not exist "0-1 to n" but "0-n to m" when multiple Scheduled Procedure Steps are satisfied by one Performed Procedure Step.

Legend:
{xxx}   : An Attribute which is a unique identifier (DICOM UID) or an identifier (DICOM ID) or for the entity
yyy   : An Attribute which is used in the entity to reference another entity as show by the associated arrow.
[n]   : The Attribute Type as defined by DICOM for this entity (IHE may strengthen this requirement)
        : A relationship between two entities using a unique identifier (DICOM UID)
        : A bidirectional relationship between two entities using a pair of unique identifiers (DICOM UID)
        : A relationship between two entities using a simple identifier (DICOM ID)
n-m   : Cardinality of the relationship between the entitties, not the identifiers. (Direction of the arrow is irrelevant to cardinality.)
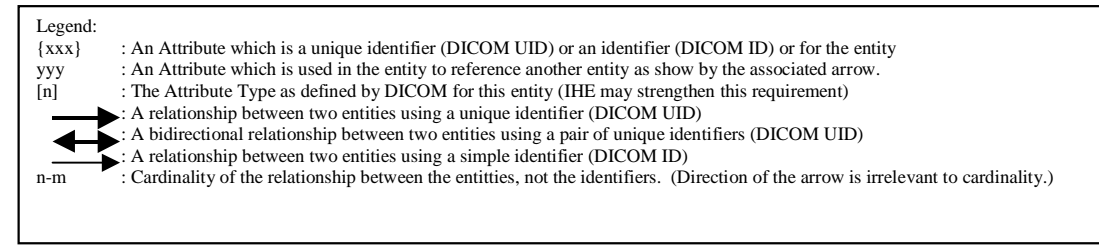
Figure C-1. Data Consistency Model: Modality Worklist Information Model, Composite IODs and Modality Performed Procedure Step IOD

Appendix D: HL7 Order Mapping to DICOM MWL

This appendix defines the mapping of the HL7 Order message (which is the ORM message as described in the New Order Transaction) to the DICOM Modality Worklist (which is the MWL DICOM Service Class as described in the Modality Worklist Transaction). Note that the ORM message addresses information regarding the order, not scheduling or resource management information. The scheduling and resource management is internal to the Department System Scheduler.

Note also that this mapping does not apply to Procedure Scheduled Transaction (message from Department System Scheduler to Image Manager). Also see the IHE ER Model and the HL7 Implementation Notes in section 2 for a more thorough definition of field lengths, value representations, and attribute types.

Mappings between HL7 and DICOM are illustrated in the following manner:

- Element Name (HL7 item_number.component #/ DICOM (group, element))
- The component value is not listed if the HL7 element does not contain multiple components.

Table D-1. HL7 Order Mapping to DICOM MWL

DICOM Description / Module	DICOM Tag	DICOM SCP Matching Key Type	DICOM SCP Return Key Type	HL7 Description	HL7 Item #	HL7 Segment	Notes
SOP Common							
Specific Character Set	(0008,0005)	O	1C	Principal Language of Message	00693	ORM MSH:18	
Scheduled Procedure Step							
Scheduled Procedure Step Sequence	(0040,0100)	R	1				
>Scheduled station AE title	(0040,0001)	R	1				Generated by the department system scheduler
>Scheduled Procedure Step Start Date	(0040,0002)	R	1				Generated by the department system scheduler
>Scheduled Procedure Step Start Time	(0040,0003)	R	1				Generated by the department system scheduler
>Modality	(0008,0060)	R	1				Generated by the department system

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							scheduler (note 3)
>Scheduled Performing Physician's Name	(0040,0006)	R	2	Technician	00266	ORM OBR:34	
>Scheduled Procedure Step Description	(0040,0007)	O	1C				Generated by the department system scheduler
>Scheduled Station Name	(0040,0010)	O	2				Generated by the department system scheduler
>Scheduled Procedure Step Location	(0040,0011)	O	2				Generated by the department system scheduler
>Scheduled Action Item Code Sequence	(0040,0008)	O	1C				
>>Code Value	(0008,0100)	O	1C				Generated by the department system scheduler
>>Coding Scheme Designator	(0008,0102)	O	1C				Generated by the department system scheduler
>>Code Meaning	(0008,0104)	O	3				Generated by the department system scheduler
>Pre-Medication	(0040,0012)	O	2C				
>Scheduled Procedure Step ID	(0040,0009)	O	1	N/A			Generated by the department system scheduler
>Requested Contrast Agent	(0032,1070)	O	2C	N/A			Generated by the department system scheduler
>Scheduled Procedure Step Status	(0040,0020)	O	3	N/A			Generated by the department system scheduler
>All other Attributes from the Scheduled Procedure Step Module		O	3				
Requested Procedure							
Requested Procedure ID	(0040,1001)	O	1				Generated by the department system scheduler
Requested Procedure	(0032,1060)	O	1C	Univ. Serv.	00238.2 /	ORM	See note 1

Description				ID / Specimen Source	00249.5	OBR:4 / ORM OBR:15	
Requested Procedure Code Sequence	(0032,1064)	O	1C	N/A			
>Code Value	(0008,0100)	O	1C	Univ. Serv. ID	00238.1	ORM OBR:4	See note 1
>Coding Scheme Designator	(0008,0102)	O	1C	Univ. Serv. ID	00238.3	ORM OBR:4	See note 1
>Code Meaning	(0008,0104)	O	3	Univ. Serv. ID	00238.2	ORM OBR:4	See note 1
Study Instance UID	(0020,000D)	O	1				Generated by the department system scheduler
Referenced Study Sequence	(0008,1110)	O	2				
>Referenced SOP Class UID	(0008,1150)	O	1C				
>Referenced SOP Instance UID	(0008,1155)	O	1C				
Requested Procedure Priority	(0040,1003)	O	2	Quantity/ Timing	00221.6	ORM ORC:7	See note 2
Patient Transport Arrangements	(0040,1004)	O	2	Transport Arrangement Response.	01031.1-3	ORM OBR:30	
All other Attributes from the Requested Procedure Module		O	3				
Imaging Service Request							
Accession Number	(0008,0050)	O	2				Generated by the department system scheduler
Requesting Physician	(0032,1032)	O	2	Ordering Provider	00226.1-7	ORM OBR:16	
Referring Physician's Name	(0008,0090)	O	2	Referring Doctor	00138.1-7	ORM PV1:8	
Placer Issuer and Number	(0040,2016)	O	2	Placer Order #	00216.1-2	ORM ORC:2	See note 4
Filler Issuer and Number	(0040,2017)	O	2	Filler Order #	00217.1-2	ORM ORC:3	See note 4
Reason for Imaging Service Request	(0040,2001)	O	2	Reason for Study	00263	ORM OBR:31	
Entered by….	(0040,2008)	O	3	Entered by….	00224.2-6	ORM ORC:10	
Order Entering Location	(0040,2009)	O	3	Entering Organization	00231.2	ORM ORC:17	

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Order Callback Phone Number	(0040,2010)	O	3	Order Callback Phone Number	00228	ORM ORC:14	
All other Attributes from the Scheduled Procedure Step Module		O	3				
Visit Identification							
Admission ID	(0038,0010)	O	2	Patient Account Number	00121.1	ORM PID: 18	See note 6
Issuer of Admission ID	(0038,0011)	O	2	Account Number	00121.4	ORM ORM PID:18	See note 6
All other Attributes from the Visit Identification Module		O	3				
Visit Status							
Current Patient Location	(0038,0300)	O	2	Assigned Pat. Loc.	00133	ORM PV1:3	
All other Attributes from the Visit Status Module		O	3				
Visit Relationship							
Referenced Patient Sequence	(0008,1120)	O	2				
>Referenced SOP Class UID	(0008,1150)	O	2				
>Referenced SOP Instance UID	(0008,1155)	O	2				
All other Attributes from the Visit Relationship Module		O	3				
Visit Admission							
All Attributes from the Visit Admission Module		O	3				
Patient Relationship							
All Attributes from the Patient Relationship Module		O	3				
Patient Identification							
Patient's Name	(0010,0010)	R	1	Patient Name	00108	ORM PID:5	
Patient ID	(0010,0020)	R	1	External Patient ID	00105.1	ORM PID:2	See note 5
Issuer of Patient ID	(0010,0021)	O	3	External Patient ID	00105.4	ORM PID:2	See note 5
Ethnic Group	(0010,2160)	O	3	Ethnic	00125	ORM	

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				Group		PID:22	
All other Attributes from the Patient Identification Module		O	3				
Patient Demographic							
Patients Birth Date	(0010,0030)	O	2	Date/ Time of Birth	00110.1	ORM PID:7	
Patient's Sex	(0010,0040)	O	2	Sex	00111	ORM PID:8	
Patient's Weight	(0010,1030)	O	2	Observation Value	00573.2 when 00571.2 = "Body Weight" and 00574.2 = "kg"	ORM OBX:5	See note 7
Patient's Size	(0010,1020)	O	2	Observation Value	00573.2 when 00571.2 = "Body Height" and 00574.2 = "m"	ORM OBX:5	See note 7
Confidentiality constraint on patient data	(0040,3001)	O	2				
Region of Residence	(0010,2152)	O	3	Citizenship	00129	ORM PID:26	
Military Rank	(0010,1080)	O	3	Veterans Military Status	00130	ORM PID:27	
All other Attributes from the Patient Demographic Module		O	3				
Patient Medical							
Patient State	(0038,0500)	O	2	Danger Code	00246	ORM OBR:12	
Pregnancy Status	(0010,21C0)	O	2	Ambulatory Status	00145	ORM PV1:15	"B6" must be mapped to DICOM enumerated value "3" (definitely pregnant).
Medical Alerts	(0010,2000)	O	2	Relevant Clinical Info	00247	ORM OBR:13	
Contrast Allergies	(0010,2110)	O	2	Allergy Code	00205	ADT AL1:3	
Special Needs	(0038,0050)	O	2				

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All other Attributes from the Patient Medical Module		O	3				

Adapted from DICOM PS 3.4

Notes from table D-1:

Note 1: Universal Service ID and Specimen Source decoding:

Universal Service ID (00238) contains six components and is decoded as described below. The Order Placer provides the Universal Service ID components 1-3 when it processes the order; the Department System Scheduler provides the Universal Service ID components 4-6 when it processes the order.

The first three components of the Universal Service ID is mapped into the following DICOM attributes:

- Requested Procedure Description (0032,1060)
- Requested Procedure Code Sequence (0032,1064)

It is important to clarify that the content of the Description attributes is free format text, while the content of the Code Sequence may not be altered. Also note that the coding schemes (e.g., CPT versus ACR, etc) are not defined by IHE but rather are defined by the individual institutions. Any coding schemes may be used. It is important to note that coding schemes must differentiate between laterality.

Universal Service ID (00238) components shall be decoded in the following manner:

- .1 identifier maps to Requested Procedure >Code Value (0008,0100)
- .2 text maps to both Requested Procedure Description (0032,1060) and Requested Procedure >Code Meaning (0008,0104)
- .3 name of coding scheme maps to Requested Procedure >Coding Scheme (0008,0102)

Note: If laterality is not specified in the coding scheme then it is recommended to use Specimen Source to further clarify the free format text descriptions as follows (but not the Code Sequence fields, since those cannot be altered). If laterality is specified in the coding scheme, then use of Specimen Source is unnecessary.

Specimen Source (00249) components shall be decoded in the following manner:

- .5 site modifier shall be used for the L/R indicator. The L/R value shall be appended to the Requested Procedure Description (0032,1060).

An **example** of Universal Service ID and Specimen Source decoding is:

Universal Service ID = |23455^XRAY OF ANKLE ^CodeTMS^5489.3^A/P and lateral views of Right ANKLE^CodeXYZ|

Specimen Source = |Radiology^^^^Right^|

Requested Procedure Description (0032,1060) = "XRAY OF ANKLE Right"

Requested Procedure >Code Value (0008,0100) = "23455"

Requested Procedure >Coding Scheme (0008,0102) = "CodeTMS"

Requested Procedure >Code Meaning (0008,0104) = "XRAY OF ANKLE"

For the purpose of illustration, the example given above can be continued using the components .4-6 of the Universal Service ID if were scheduled by a system external to the Department System Scheduler (e.g., a Centralized Scheduling system).

Scheduled Procedure Step Description (0040,0007) = "A/P and lateral views of Right ANKLE Right"

Scheduled Action Item >Code Value(0008,0100) = "5489.3"

Scheduled Action Item >Coding Scheme (0008,0102) = "CodeXYZ"

Scheduled Action Item >Code Meaning (0008,0104) = "A/P and lateral views of Right ANKLE"

Note 2: Only the suggested values of the HL7 Priority component of Quantity/Timing should be used for IHE. These values shall be mapped to the DICOM enumerated fields for Priority as:

HL7 Status	DICOM Status
S - STAT	STAT
A - ASAP	HIGH
R - Routine	ROUTINE
P - Pre-op	HIGH
C - Callback	HIGH
T - Timing	MEDIUM

Note 3: The HL7 Diagnostic Service Section ID (00257)is being mapped directly into DICOM Modality, which is a defined term. The DICOM defined terms must be used for the MWL response as listed in DICOM PS 3.3.

Note 4: A Change Proposal has been accepted by DICOM Working Group VI to add attribute (0040,2016) and (0040, 2017) to incorporate the HL7 components of Placer Issuer and Number, and Filler Issuer and Number. In a healthcare enterprise with multiple issuers of patient identifiers, both the issuer name and number are required to guarantee uniqueness.

Note 5: Please refer to section 4.1 for a more thorough discussion on the mapping of Patient ID and Issuer of Patient ID.

Note 6: As described in section 4.3, the use of PID:18 Patient Account Number alone may not be sufficient to uniquely identify an encounterPV1:19 Visit Number is often used in addition to PID_18. However, because table D-1 represents a mapping to MWL, and because Visit information is not migrated into the C-Store composite object, it is assumed that the PV1:19 information will be sufficient for purposes of MWL.

Note 7: Patient's Weight and Patient's Size are two observations from multiple OBX segments. A coding scheme is not specified by IHE, but rather, the text values of "Body Weight" and "Body Height", respectively, are required to differentiate the two measurements. Note that DICOM specifies the use of "kg" and "m", respectively, for these measurements. An example of this HL7 encoding is:

OBX||ST|^BODY WEIGHT||^62|^kg

OBX||ST|^BODY HEIGHT||^1.90|^m

Note 8: The DICOM attribute (0038, 0050) Special Needs is listed in table D-1 with no specific mapping from an HL7 message. In the IHE demonstration, this value is to be provided by the DSS/Order Filler. The prospect of mapping this attribute to an HL7 value will be examined in the future.

Appendix E: Departmental Access to Non-Radiology Information

E.1:   Scope

The access to non-radiology reports external to the imaging department is supported in the IHE Technical Framework by leveraging the Query Report and Retrieve Report Transactions also used to access imaging department Structured Reports (see sections 6.26 and 6.27). The External Report Repository Access provides a method to retrieve from the other department's reports (e.g. Laboratory).

The IHE Technical Framework does not restrict the manner in which this External Report Repository Access is implemented. It may, for example:

- Be a Laboratory Repository System that directly supports this actor and the associated Query Report and Retrieve Report Transactions;
- Accept the Query Report and Retrieve Report Transactions on one side and translate them into another query transaction supported by a specific laboratory report repository.

This appendix discusses the constraints that this External Report Repository Access needs to support for its proper integration.

E.2:   Query Protocol

The assumptions under which the External Report Repository Access operates are:

1.   The External Report Repository Access is responsible for formatting other department reports (e.g. laboratory report) into a DICOM Structured Report object (for content constraints see section E.3). The prime focus for the IHE Technical Framework: Year 2 will be laboratory reports, although other department's reports may be supported.

2.   Consistent Patient IDs will be used in the laboratory (or other) department reports and in the imaging department. This will ensure that a Patient ID of an image displayed by an Image Display, can be used as a key to retrieve recent laboratory reports for the same patient. This implies that the laboratory information system is integrated with the same ADT Patient Registration (although this integration is not within the scope of the IHE Technical Framework: Year 2).

3.   The Study and Series groupings are not specified by the IHE Technical Framework and may be arbitrarily used by the External Report Repository Access. For example, a DICOM Study may be created for each order (Accession Number) which contains one or more laboratory reports, a Series may be created for each laboratory request and so may contain mostly one report, unless amended. Alternatively, a single Series may be created and contain multiple reports if different laboratory exams were requested in the same order.

4. Study Instance UIDs, Series Instance UIDs and SOP Instance UIDs may be created by the External Report Repository Access to group one or more of its Reports. Those UIDs need to be properly formed DICOM UIDs, i.e. use a registered root.

5. If the same Report is being queried and retrieved several times, the same set of Study, Series and SOP Instance UIDs shall be provided by the External Report Repository Access. This ensures that two separate queries selecting the same report will identify the same instance and retrieve an identical copy. This is important to avoid multiple copies with the same content confusing the clinician.

6. Table E.2-1 shows the minimal set of matching and return keys that shall be supported by the External Report Repository Access as an SCP at the different DICOM Hierarchical Levels. It is a reduced set from the radiology department keys (see sections 6.14.4.1.2). Additional SR Instance specific keys that shall be supported by the External Report Repository Access as an SCP are defined in section 6.26.4.1.2 and table 6.26-1. Minimum DICOM conformance is still required. Conventions for table E.2-1 may be found in section 2.2.

Note: The use of N/A (Not Applicable) in the SCU columns is because the External Report Repository Access is only an SCP of the query request.

Table E.2-1. Query Matching and Return Keys

Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Study Level						
Study Date	(0008,0020)	N/A	R	N/A	R	
Study Time	(0008,0030)	N/A	R	N/A	R	
Accession Number	(0008,0050)	N/A	R	N/A	R	
Patient Name	(0010,0010)	N/A	R	N/A	R	IHE-1, IHE-2
Patient ID	(0010,0020)	N/A	R	N/A	R	
Study ID	(0020,0010)	N/A	R	N/A	R	
Study Instance UID	(0020,000D)	N/A	R	N/A	R	
Referring Physician's Name	(0008,0090)	N/A	R+	N/A	R+	IHE-1, IHE-2
Study Description	(0008,1030)	N/A	O	N/A	O	
Procedure Code Sequence	(0008,1032)	N/A	O	N/A	O	IHE-3
Patient's Birth Date	(0010,0030)	N/A	O	N/A	R+	
Patient's Sex	(0010,0040)	N/A	O	N/A	R+	
Series Level						
Modality	(0008,0060)	N/A	R	N/A	R	IHE-5
Series Number	(0020,0011)	N/A	R	N/A	R	
Series Instance UID	(0020,000E)	N/A	R	N/A	R	
Composite Object Instance Level						

Instance Number	(0020,0013)	N/A	R	N/A	R	
SOP Instance UID	(0008,0018)	N/A	R	N/A	R	
SOP Class UID	(0008,0016)	N/A	R+	N/A	R+	IHE-4

IHE-1: Case insensitive matching is allowed in the IHE Technical Framework: Year 2, for attributes of VR PN. A DICOM Change Proposal (CP 190) to allow case insensitivity on PN attributes is currently pending.

IHE-2: SCUs are recommended to append wildcard "*" at the end of each component of any structured name to facilitate matching (i.e., PN attributes).

IHE-3: Universal Matching (selecting return keys) against an Attribute of VR SQ should be requested by the Query SCU using a Zero Length Sequence Attribute. Query SCPs shall accept such Universal Match Requests. In addition, Query SCPs are required by the DICOM Standard to support requests for a Universal Match for an SQ attribute encoded as a zero length item.

IHE-4: A SOP Class UID is a non-ambiguous key to identify a specific type of image (Modality is not).

IHE-5: The Modality Matching Key will always be set to "SR"

E.3: External Report Content

The requirements for coded entries and report structure for reports handled by the External Report Repository via the Query Report and Retrieve Report Transactions shall be similar to the Report Creator (see section 6.24.4.1.2.1):

- The types of reports generated by the External Report Repository are defined in section 5.3.2. The External Report Repository shall be able to generate reports based on the Simple Image Report (section 5.3.2.2) with optional image references. If image references are supported by the External Report Repository then it shall also support the Key Image Report (section 5.3.2.1). If the External Report Repository supports the Enhanced SR Information Object Definition then it shall also support the generation of Simple Image and Numeric Reports (section 5.3.2.3).

- A specialized set of Report Titles, Report Section Headings, Concept Name Codes, Observation Context Codes, Measurement Codes and Disposition or Conclusion Codes will be defined for each type of department repository accessed (e.g. laboratory codes for laboratory departments)

Appendix F: Overview of the Information Exchange between DSS/Order Filler and Image Manager

Information exchange between the DSS/Order Filler and the Image Manager is performed on the intra-departmental level. Each actor manages a distinct domain of information within a department: patient, order and procedure performance information for the DSS/Order Filler; image acquisition, storage and interpretation for the Image Manager. Each system, however, requires valid and current information from both domains.

F.1: Exchange of Patient Information

The DSS/Order Filler is a source of patient information for the Image Manager within the context of a department. The Image Manager does not receive information for a particular patient until the first order for a patient has been submitted to the department and corresponding procedures have been scheduled. At this point, the DSS/Order Filler will communicate patient information to the Image Manager within Transaction 4: Procedure Scheduled.

Subsequent updates of patient information are communicated by the DSS/Order Filler to the Image Manager via Transaction 12: Patient Update. These changes will be reflected on the Image Manager and in the images and Grayscale Softcopy Presentation State objects retrieved from the Image Archive. No patient information changes should be initiated by the Image Manager.

F.2: Exchange of Visit and Order Information

The DSS/Order Filler is a source of visit and order information for the Image Manager. The Image Manager does not receive information for a particular patient's visit until the first order for a patient originated within such a visit has been submitted to the department and corresponding procedures have been scheduled. At this point, the DSS/Order Filler will communicates visit and order information to the Image Manager within Transaction 4: Procedure Scheduled.

Subsequent updates of visit information are communicated by the DSS/Order Filler to the Image Manager via Transaction 12: Patient Update. These changes will be reflected on the Image Manager and in the images and Grayscale Softcopy Presentation State objects retrieved from the Image Archive. No visit information changes should be initiated by the Image Manager.

Because the IHE Technical Framework requires that the order information change will be performed through cancellation of the order in question and re-order, updates of order information are communicated by the DSS/Order Filler to the Image Manager via a sequence of two transactions - Transaction 13: Procedure Update (conveying order cancel) and Transaction 4: Procedure Scheduled (conveying new order information). No order information changes should be initiated by the Image Manager.

F.3: Exchange of Procedure Information

The DSS/Order Filler is a source of Requested Procedure information for the Image Manager. The Image Manager does not receive information for a particular procedure until it has been scheduled. At this point, the DSS/Order Filler will communicate visit and order information to the Image Manager within Transaction 4: Procedure Scheduled.

Subsequent updates of procedure information (re-scheduling, change of procedure code, etc.) are communicated by the DSS/Order Filler to the Image Manager via Transaction 13: Procedure Update. No Requested Procedure information changes should be initiated by the Image Manager.

Certain imaging information, submitted to the Image Manager from the Acquisition Modality, shall not be subject of change by either the DSS/Order Filler or the Image Manager. This information includes Study Instance UID and the Performed Procedure, Performed Procedure Step and Performed Action Item information.

Appendix G: Clarification of Patient Identifiers for Merge Cases

G.1:   Introduction

IHE Technical Framework: Year 2 has adopted the changes in HL7 2.3.1 Patient Identifiers. This includes:

- HL7 v2.3 External Patient ID (PID –2) has been retained for backward compatibility.
- Alternate Patient ID (PID-4) has been retained for backward compatibility.
- Internal Patient ID (PID-3) has been renamed "Patient Identifier List" and is now allowed to repeat.

Due to the adoption of these HL7 2.3.1 changes, IHE mandates the use of assigning authority (issuer) in PID-3 component 4 and identifier in PID-3 component 1.

Since the DICOM Patient ID attribute (0010,0020) does not convey assigning authority and the Issuer of Patient ID (0010,0021) is an optional attribute in DICOM, both the Image Manager Actor and the Department System Scheduler/Order Filler Actor should be prepared to make assumptions regarding the assigning authority for Patient IDs transmitted from a Modality via DICOM Modality PPS. It is assumed that it is possible to recognize a valid range of patient identifiers assigned by a single ADT Actor or single issuer of identifiers within an enterprise.

The identifier in PID-3 in all HL7 transactions specified by the IHE shall be single valued and used by the ADT/Patient Registration actor, except for Transaction 4 which may use an identifier assigned by the DSS/Order Filler.

In future years of IHE with the introduction of an MPI, it is assumed that the MPI identifier will be used in PID-3 for all HL7 transactions.

It is required that the healthcare institution configure the issuer of temporary patient identifiers to be either the ADT Issuer or the Departmental Issuer in both the Image Manager and the DSS/Order Filler. This will ensure that Patient ID in DICOM (0010,0020) is associated with the same assigning authority when mapped into a PID-3 in HL7 messages.

Although, an organization may operate with temporary patient identifiers issued by the ADT and used primarily in Cases 1,2 and 3, Case 5 may occur. This may happen due to Modality operator errors when manually entering patient identifier in Case 3. In this situation, DSS/Order Filler and Image Manager shall recognize the error and associate the erroneous identifier to the same issuer. The reconciliation will happen on the DSS/Order Filler and it will send the Patient Merge message to the Image Manager where both "new" and "old" patient identifiers are associated with the same issuer.

The use of PID-3 is illustrated in the following sections using the section 5 use cases. In the examples given below time flows from the top row of the table to the bottom.

Table Acronyms	Description
IM	Image Manager
OF	Order Filler / Departmental System Scheduler
OP	Order Placer
PPSM	Performed Procedure Step Manager

G.2: Administrative Process Flow (Section 5.1.1)

The illustration includes A01, A04, A05, A11, and A30 although only an A01 is included in this example.   The ADT identifier number used in the example below is "123", the assigning authority is "ADT_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
A01 (ADT -> OF)	123^^^ADT_Issuer	N/A	N/A
A01 (ADT -> OP)	123^^^ADT_Issuer	N/A	N/A
ORM (OP->OF)	123^^^ADT_Issuer	N/A	N/A
ORM (OF->IM)	123^^^ADT_Issuer	N/A	N/A
DICOM MWL (OF -> Modality)	N/A	123	N/A
PPS (Modality -> PPSM)	N/A	123	N/A
PPS (PPSM -> IM)	N/A	123	N/A
PPS (PPSM -> OF)	N/A	123	N/A

G.3: Patient Merge (Section 5.1.2)

This specifically looks at the Patient merge scenario in section 5.1.2.2. The "old" ADT identifier number used in the example below is "123", the assigning authority is "ADT_Issuer".   The "new" ADT identifier number used in the example below is "456", the assigning authority is "ADT_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
A01 (ADT -> OF)	123^^^ADT_Issuer	N/A	N/A
A01 (ADT -> OP)	123^^^ADT_Issuer	N/A	N/A
ORM (OP->OF)	123^^^ADT_Issuer	N/A	N/A
ORM (OF->IM)	123^^^ADT_Issuer	N/A	N/A
DICOM MWL (OF -> Modality)	N/A	123	N/A
A40 (ADT -> OF)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer
A40 (OF->IM)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer

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A40 (ADT -> OP)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer

G.4: Trauma Cases 1 and 2 (Section 5. 4)

The ADT temporary identifier for "John Doe" used in the example below is "Temp_123", the assigning authority is "ADT_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
A01 (ADT -> OF)	Temp_123^^^ADT_Issuer	N/A	N/A
A01 (ADT -> OP)	Temp_123^^^ADT_Issuer	N/A	N/A
ORM (OP->OF)	Temp_123^^^ADT_Issuer	N/A	N/A
ORM (OF->IM)	Temp_123^^^ADT_Issuer	N/A	N/A
DICOM MWL (OF -> Modality)	N/A	Temp_123	N/A
PPS (Modality -> PPSM)	N/A	Temp_123	N/A
PPS (PPSM -> IM)	N/A	Temp_123	N/A
PPS (PPSM -> OF)	N/A	Temp_123	N/A
A40 (ADT -> OF)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer
A40 (OF->IM)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer
A40 (ADT -> OP)	456^^^ADT_Issuer	N/A	123^^^ADT_Issuer

G.5: Trauma Case 3 (Section 5. 4)

The ADT temporary identifier number for "John Doe" used in the example below is "Temp_123". The patient will later be assigned a permanent identifier of "Real_456", the assigning authority is "ADT_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
A01 (ADT -> OF)	Temp_123^^^ADT_Issuer	N/A	N/A
A01 (ADT -> OP)	Temp_123^^^ADT_Issuer	N/A	N/A
(Note: Temporary Patient ID "Temp_123" is manually entered at the modality.)	N/A	N/A	N/A
PPS (Modality -> PPSM)	N/A	Temp_123	N/A
PPS (PPSM -> IM)	N/A	Temp_123	N/A
(Note: The IM recognizes an unscheduled PPS and assumes a site configured assigning authority of	N/A	N/A	N/A

"ADT_Issuer".)			
PPS (PPSM -> OF)	N/A	Temp_123	N/A
(Note: The OF recognizes an unscheduled PPS with a valid ADT Patient ID – with a site configured assigning authority of "ADT_Issuer".)	N/A	N/A	N/A
ORM (OF-> OP)	Temp_123^^^ADT_Issuer	N/A	N/A
ORR (OP->OF)	Temp_123^^^ADT_Issuer	N/A	N/A
ORM (OF-> IM)	Temp_123^^^ADT_Issuer	N/A	N/A
(Note: Patient Reconciliation occurs on the ADT system.)	N/A	N/A	N/A
A40 (ADT -> OF)	Real_456^^^ADT_Issuer	N/A	Temp_123^^^ADT_Issuer
A40 (ADT -> OP)	Real_456^^^ADT_Issuer	N/A	Temp_123^^^ADT_Issuer
A40 (OF-> IM)	Real_456^^^ADT_Issuer	N/A	Temp_123^^^ADT_Issuer

G.6: Trauma Case 4 (Section 5.4)

The OF temporary identifier number for "John Doe" used in the example below is "Dept_789". The Patient will later be assigned a permanent identifier of "123", the assigning authority is "OF_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
ORM (OF->IM)	Dept_789^^^OF_Issuer	N/A	N/A
DICOM MWL (OF->Modality)	N/A	Dept_789	N/A
PPS (Modality -> PPSM)	N/A	Dept_789	N/A
PPS (PPSM -> IM)	N/A	Dept_789	N/A
(Note: The IM recognizes a scheduled PPS with a Patient ID - with a site configured assigning authority of "OF_Issuer".)	N/A	N/A	N/A
PPS (PPSM -> OF)	N/A	Dept_789	N/A
(Note: The OF recognizes a scheduled PPS with a Patient ID issued by the OF.)	N/A	N/A	N/A
A01 (ADT -> OP)	123^^^ADT_Issuer	N/A	N/A
A01 (ADT -> OF)	123^^^ADT_Issuer	N/A	N/A
(Note: The patient Dept_789^^^OF_Issuer is manually reconciled with 123^^^ADT_Issuer.)	N/A	N/A	N/A
A40 (OF-> IM)	123^^^ADT_Issuer	N/A	Dept_789^^^OF_Issuer
ORM (OF-> IM)	123^^^ADT_Issuer	N/A	N/A

Transaction			
ORM (OF-> OP)	123^^^ADT_Issuer	N/A	N/A
ORR (OP->OF)	123^^^ADT_Issuer	N/A	N/A

G.7:   Trauma Case 5 (Section 5. 4)

The temporary identifier number for "John Doe" used in the example below is "Dept_123" and is manually entered on the Modality. The patient will later be assigned a permanent identifier of "Real_456", the assigning authority is "OF_Issuer".

Transaction	PID-3 (Patient Identifier List)	DICOM (0010,0020)	MRG-1 (Prior Patient Identifier List)
PPS (Modality ->IM)	N/A	Dept_123	N/A
(Note: The IM recognizes an unscheduled PPS and assumes a site configured assigning authority)	N/A	N/A	N/A
PPS (IM->OF)	N/A	Dept_123	N/A
(Note: The OF recognizes an unscheduled PPS and assumes a site configured assigning authority; recognizes that Patient ID is invalid.)	N/A	N/A	N/A
A01 (ADT->OF)	Real_456^^^ADT_Issuer	N/A	N/A
A01 (ADT->OP)	Real_456^^^ADT_Issuer	N/A	N/A
(Note: Manual patient reconciliation occurs on the OF system.)	N/A	N/A	N/A
A40 (OF-> IM)	Real_456^^^ADT_Issuer	N/A	Dept_123^^^Configured_Issuer
ORM (OF-> OP)	Real_456^^^ADT_Issuer	N/A	N/A
ORR (OP->OF)	Real_456^^^ADT_Issuer	N/A	N/A
ORM (OF-> IM)	Real_456^^^ADT_Issuer	N/A	N/A

GLOSSARY

Terms Specific to this Document

Accession Number: A user-friendly identifier created by the Departmental System, which identifies an instance of a filler order or imaging service request. It may group one or more requested procedures.

Actor: An entity within a use case diagram which can perform an action within a use case diagram. Possible actions are creation or consumption of a message

Expected Actions: Actions which should occur as the result of a trigger event

Foreign Key (FK): A database key which is used as a reference to relate one entity to another entity. It may be a unique value, or used in conjunction with another Foreign Key to create a unique value.

Images Available: A transaction or transactions used to determine that images have been stored in an image archive and may be retrieved.

Interaction Diagram: A diagram which depicts data flow and sequencing of events

Pre-fetch: The activity of fetching images or other information objects from previously completed procedures to near-term storage for review of those data.

Process Flow Diagram: A graphical illustration of the flow of processes and interactions among the actors involved in a particular example

Role: The actions of an actor in a use case.

Scope: A brief description of the process step.

Trigger Event: An event such as the reception of a message or completion of a process, which causes another action to occur.

Use Case: A graphical depiction of the actors and operation of a system.

DICOM Terms

Action Item: See DICOM PS 3.3

Basic Color Print Management Meta SOP Class: See DICOM PS 3.4

Basic Grayscale Print Management Meta SOP Class: See DICOM PS 3.4

Basic Text SR Storage SOP Class: See DICOM Supplement 23

DICOM Model of the Real World: See DICOM PS 3.3

Enhanced SR Storage SOP Class: See DICOM Supplement 23

Grayscale Softcopy Presentation State Storage SOP Class: See DICOM PS 3.4

Grayscale Standard Display Function: DICOM PS 3.14

Imaging Service Request: See DICOM PS 3.3

Modality: See DICOM PS 3.3

Modality Worklist SOP Class: See DICOM PS 3.4

Modality Performed Procedure Step: See DICOM PS 3.3

Modality Performed Procedure Step Information Module: See DICOM PS 3.3

Modality Performed Procedure Step Relationship Module: See DICOM PS 3.3

Modality Performed Procedure Step SOP Class: See DICOM PS 3.4

Patient: See DICOM PS 3.3

Patient Identification Module: See DICOM PS 3.3

Print Presentation LUT SOP Class: See DICOM PS 3.4

Procedure Plan: See DICOM PS 3.3

Procedure Type: See DICOM PS 3.3

Requested Procedure: See DICOM PS 3.3

Requested Procedure Module: See DICOM PS 3.3

Requested Procedure ID: See DICOM PS 3.3

Results Information Object Definition: See DICOM PS 3.3

Scheduled Procedure Step: See DICOM PS 3.3

Scheduled Procedure Step Module: See DICOM PS 3.3

Storage Commitment SOP Class: See DICOM PS 3.4

Stored Print SOP Class: See DICOM PS 3.4

Structured Reporting SOP Classes: See DICOM Supplement 23

Unique Identifier (UID): See DICOM PS 3.5

HL7 Terms

ADT: See HL7 version 2.3.1

Battery: See HL7 version 2.3.1

Filler: See HL7 version 2.3.1

Observation: See HL7 version 2.3.1

Placer: See HL7 version 2.3.1

Universal Service ID: See HL7 version 2.3.1

Acronyms and Initialisms

GSPS: Grayscale Softcopy Presentation State

HIMSS: Healthcare Information and Management Systems Society

HIS: Hospital Information System

IHE: Integrating the Healthcare Enterprise

IOD: Information Object Definitions

LUT: Look Up Table
MPI: Master Patient Index
MWL: Modality Worklist
MPPS: Modality Performed Procedure Step
NEMA: National Electrical Manufacturers Association
PACS: Picture Archive and Communication System
PPS: Performed Procedure Step
RIS: Radiology Information System
RSNA: Radiological Society of North America
SCU: Service Class User
SCP: Service Class Provider
SR: Structured Report
UID: Unique Identifier